MARCH 20, 1937

Railway Age

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Railway Age

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In This Issue

The Railway Age is indexed by the Industrial Arts Index and also by the Engineering Index Service

The Week at a Glance

CARLOADINGS: Revenue freight loadings for the March 6 week added up to 734 thousand cars. This was 16 per cent better than last year, and 5½ per cent better than the preceding week (which contained Washington's birthday).

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1936 NET: Net income of the Class I roads, after all charges, was 170 millions last year, as compared with a net loss of 1⅓ millions in 1935 and larger losses in preceding years. But, lest some mistakenly conclude that the railroads are rolling in wealth, it is well to recall that, even in 1930, net income was 524 millions—or more than 3 times as much as last year.

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TURBO-LOCO: Two 2,500-hp. "Steamotive" units for the U.P.'s double-cabbed turbo-electric locomotive are described herein. The engine will be practically smokeless and is designed to haul the "Challenger" or the "Los Angeles Limited" (standard-weight trains) at 110 m.p.h. on level.

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HOGHEAD HONORED: The Pacific Railway Club, which has long had an enviable record for active participation in its affairs by railroaders in the ranks, has chosen a W. P. locomotive engineer, Homer Bryan, as its president for the ensuing year. Other officers of the club include a prominent professor of transportation, a railway executive officer, an assistant superintendent, and a safety and public relations officer. The retiring president is a fuel supervisor. How's that list for an example of real democracy?

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I.C.C. JUBILEE: The lawyers who make a living by trying cases before the I.C.C. are sponsoring the celebration on May 31-April 1 of the 50th anniversary of that powerful body (which, by the way, thank goodness, nobody seems to have yet called the "eleven old men"). Among the headliners from Capitol Hill who will add glitter to the occasion are the following honorables: Burton Wheeler, Sam Rayburn and Clarence Lea. The President will prepare a special message to commemorate the occasion.

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PENSIONS: The railroads and the labor executives have signed an agreement covering pensions to employees 65 and over (or, with certain restrictions, at an earlier age), which will take this vexing question out of the courts and out of politics—provided Congress passes the legislation which railroads and unions join in asking. An enlightened guess as to the number of present employees who will be eligible to immediate pensions, if the legislation passes, is 50,000—with about 55,000 existing pensioners also to be taken over.

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RECOVERY THREAT: Prosperity requires a relationship between wage levels, industrial prices and farm prices at which the various producing classes can afford to buy each other's goods and services. The severity of the depression during the past few years came from the fact that the bottom dropped out of farm prices, while industrial prices and wages declined only moderately. Due to the resulting lack of balance, farmers could not buy industrial products, and industrial production and employment declined. Now conditions are much better because farm prices have been restored to some degree of parity with industrial prices and wages. But recent rapid advances in wages and consequent increases in industrial prices threaten to bring inflation and to destroy the price parities on which prosperity is based—such is the warning given this week in Washington by the prominent New Dealer, Marriner S. Eccles, chairman of the Federal Reserve Board.

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C.I.O. AND R.R. LABOR: Are the victories of John L. Lewis' industrial unions a cause for rejoicing—or for apprehension—on the part of organized railway labor? The leading editorial herein contends that the C.I.O. idea might be a real danger to the standard railway labor organizations, and to the welfare of their members; and points out some of the present policies which expose the present type of organization to competitive attack by the industrial type.

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FEBRUARY PREVIEW: Totals for February of about four-fifths of the roads show total operating revenues only 6 per cent above last year. Freight revenues were up 6.6 per cent and passenger revenue less than 2 per cent. The laggards were the Eastern roads, whose gross was up only a little over 2 per cent, while the Western lines did 12 per cent and the Southern lines 10 per cent more gross respectively. *Passenger revenues on the Eastern railways were 4 per cent under last year,* while in the West they were up 16⅓ per cent and in the South 7½ per cent. Floods and the absence of winter sports probably cut into the passenger revenues in the East somewhat.

●

FARES TOO LOW?: If passenger rates had not been reduced last year, the railroads would have earned 10.6 per cent of operating revenues from passenger service instead of only 10.2 per cent—such is the conclusion of Col. Leonard P. Ayres of the Cleveland Trust Co. and nationally-famous economist. He believes that, if fares had not been reduced, the railways would have earned larger gross revenues and that they would have saved money in operating expenses by not having to handle so many customers. The Colonel is a learned and competent observer, but the analysis he presents is not exhausive; and the subject is one which has many aspects, some of which are intangible. This department inclines to the view, for instance, that public concern for the railways' welfare is greater, the more they use railway service; and well-filled trains are certainly a tonic for employee morale.

INCOME BONDS: A requirement by the I.C.C. for the issue of preferred stocks in reorganizations rather than income bonds will seriously impair railroad credit with institutional investors—in the opinion of Kenneth D. Steere, C. & E. I. board chairman, set forth in defending the debtor's plan for the reorganization of that property before the Commission this week. Moreover, he also warned, such a requirement would result in years of litigation. If the institutional investors are thus ousted as a source of railroad financing, he added, then the carriers' only recourse will be to the speculative market.

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EQUIPMENT MARKETS: The week brought orders for 300 freight cars and 10 locomotive tenders, the former being placed by the Grand Trunk Western and the latter by the Lehigh Valley. Meanwhile inquiries for from 4450 to 4850 freight cars were issued by the Pennsylvania, the Minneapolis, St. Paul and Sault Ste Marie, the Central of Georgia and the Atlantic Coast Line. A.C.L. is also after 30 passenger-train cars and is considering the purchase of locomotives.

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FARMERS ON 4TH SEC.: National farm organizations favoring the Pettengill Bill to repeal the long-and-short-haul clause include the American Farm Bureau Federation and the American Fruit and Vegetable Shippers Association, it is disclosed in the printed report of the majority of the House Interstate Commerce Committee which has reported the bill favorably. The enumeration of other groups and societies which have gone on record in support of the measure require for their listing more than 12 pages of fine print in the committee's report.

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THUMBS DOWN: The following statesmen, members of the House Interstate Commerce Committee, have by their adverse vote on the Pettengill bill recorded their opposition to an even break for the railroads, their employees and shippers-by-rail: Bulwinkle (D., Gastonia, N. C.); Chapman (D., Paris, Ky.); Cole (D., Glenarm, Md.); Sadowski (D., Detroit); O'Connell (D., Butte, Mont.); Boren (D., Seminole, Okla.); Holmes (R., Worcester, Mass.).

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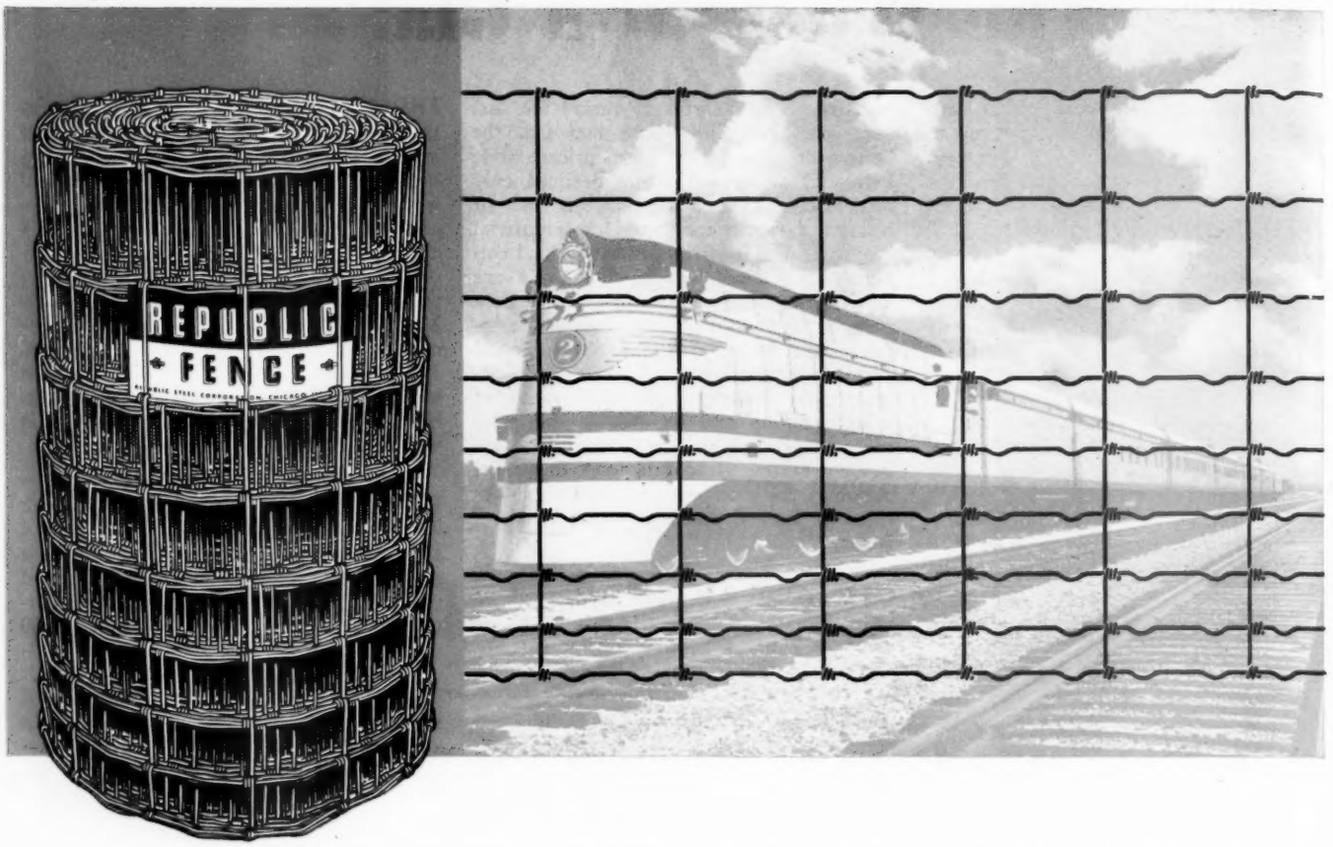
WHEELER GETS 150 GRAND: Senator Wheeler has received the okay of the Senate audit committee on the additional appropriation of $150,000 he sought to continue his sleuthing into railway finance. In an interim report the Senator (referring to the Van Sweringen "empire") suggests study into necessity for legislation to bring under I.C.C. jurisdiction the "passing from one hand to another" of control held by "thin equity investment"; and into the desirability of control of large corporations by "individuals who have themselves no appreciable financial interest" in the properties.



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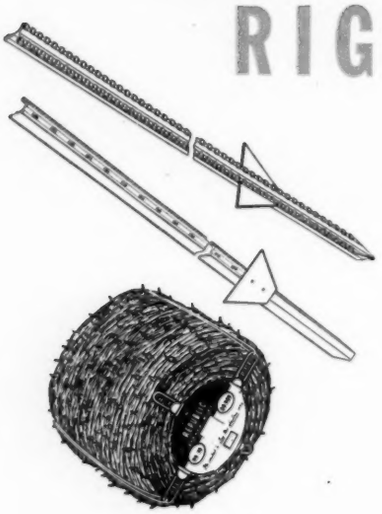

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RAILWAY AGE

The C.I.O. Movement And the Railway Labor Unions

Organized labor, not without some assistance by the government, has won some notable victories in recent weeks. These victories, however, have been won by a type of unionism which is the antithesis of that which prevails in the railway industry; and such victories bear a threat as much as they do a promise to railway unionism as it now exists. The railways are organized, of course, on craft lines, with the more strategically placed and higher skilled crafts—particularly those in train and engine service—securing in higher wages and more favorable hours and working conditions the reflection of their skill and the strategic economic position they occupy.

C. I. O. Victories a Threat to Railway Labor?

What would continued victories of industrial unionism, and consequent invasion of the railway industry by such unionism lead to? Obviously, the type of unionism which would bring a section hand and a cinder pit laborer into the same organization and with equal membership rights with conductors and locomotive engineers would tend to elevate the lower paid at the expense of those who now are advantaged by the strategic importance of the positions they hold. It might be argued that greater equality would be achieved by leveling the lower-paid upward rather than pulling down the higher scales. It would, however, obviously be impossible to pay all railway labor substantially the hourly earnings of the highest-paid employees and still keep the railroads in operation, even with government ownership and heavy subsidies out of the public treasury. As George E. Sokolsky, the well-known student of labor problems, has written in the March "Atlantic Monthly":

> . . . the trend of the [C.I.O. type] movement is to level downward. If common labor is to be paid more, and prices are not to rise,* skilled labor will have to be paid less. Technological improvements will have to be made to reduce the number of expensive skilled laborers, and to employ in their place less expensive unskilled or semi-skilled workers. . . .

Would "One Big Union" Protect Highly Skilled?

Practical union men will recognize from their own experience that substantial equality within a union is essential to its peace and harmony. An engine service union, for instance, cannot "get away" with securing an improvement in conditions for freight service employees without soon following it with a similar effort in behalf of its members who are in passenger service. Peace "in the family" requires that no one group of the membership be favored over another group. Obviously, then, if track laborers and dispatchers, flue borers and locomotive enginemen were included in one big union of the kind which is being fostered in the steel and automotive industries, the higher paid and greater skilled would, from the nature of the organization, lose the preferred position they now enjoy.

The tendency toward equality of wages which flows from industrial, as opposed to craft, unionism is no mere theory. In England the predominant railway union is the National Union of Railwaymen, an industrial union. Competitive with it for a relatively small proportion of the employees—enginemen and clerks—are separate craft unions. Nevertheless, the industrial union idea has gained a strong foothold, and in all probability this accounts in part at least for the fact that the spread between the wage rates of the lowest grade of unskilled labor and the highest paid employees is nowhere near as great as it is in this country. In

* It is a noteworthy fact that powerful forces have recently exerted themselves to drive freight rates down on the very commodities the prices of which were being raised by their producers.—EDITOR.

November, 1936, for instance, on the American railways, the straight time hourly earnings of passenger engineers averaged more than five times as much as those of section hands and more than four-and-a-half times as much as the earnings of coach cleaners. In Britain, by contrast, according to the latest figures available to us, the average earnings of locomotive engineers were less than twice as great as those of the lowest paid track labor, and only slightly more than twice as much as the earnings of coach cleaners.

Yet in Britain there is an acceptance of social and economic class distinctions to an extent entirely unknown in this country. If some measure of industrial unionism in a country such as the United Kingdom has sufficed to narrow the range of railway wages as much as it has—then what is its effect likely to be in this country in which, regardless of skill or education, "every man feels himself to be the equal of every other man, if not a damned sight better."

Higher Prices Would Harm Unprotected Worker

Even if industrial unionism did not serve immediately to pull down the wages of the highest paid, it would certainly leave their condition static, while efforts were concentrated on pulling up the lower paid. Industrial unionization in the steel industry has already brought about large increases in the prices of steel products. It threatens to have the same effect in other industries to which it is applied. If industrial unionism, as it must in the long run, works more assiduously to improve the lot of the unskilled and has the effect of raising the general price level, then skilled labor will find its costs of living rising but with no effective organization working to bring commensurate increases in its wages. The effects of a triumph of industrial unionism, whatever they may be on industrial prosperity, are certain in the long run to bring a lower relative, and probably a lower absolute, status for the more highly skilled occupations. When it is recalled that track laborers alone on the American railways equal if they do not outnumber train and engine service employees in road service, the vulnerability of the latter in the face of a general triumph of the C.I.O. idea over craft unionism is obvious.

Craft Unionism's Record of Accomplishment

Industrial unionism, being a mass movement with a strong political complexion, offers, of course, potentially more danger to industrial peace in the hands of irresponsible leadership than do the craft unions. There are many members of long standing in the railway labor organizations who have never been out on strike a day in their lives, offering a strong contrast to such an industrial union, for example, as the United Mine Workers. And who can doubt, either, that the great bulk of organized railway employees—including those who are members of the relatively weaker organizations—are vastly better off than the average member of the miner's organization; and not only are better off now, but have been so for years?

Perhaps the victories which the John L. Lewis type of labor organization have been winning signify nothing more than a stronger national labor movement. Perhaps these victors will be content to extend themselves only in those industries not heretofore organized. Perhaps they will not set up competitive organizing efforts in industries already organized along craft lines. If no such competition is initiated, then the success of the C.I.O. unions in heretofore unorganized industries may not be a matter of direct concern to organized railway employees. But, if organized railroaders value the favorable position they now hold, they might at least consider what they would be likely to lose by industrial unionization, and they might profitably consider wherein they are open to attack by a competing industrial union, and take the necessary precautions. Wherein are the standard labor organizations vulnerable to such competition?

Is Present Wage Spread Too Wide?

Obviously too wide spreads in earnings between the highest paid and the lowest—when the lowest are numerically strong—is an open invitation to mass action which will reduce that spread. The constantly increasing rate of hourly earnings of train and engine service employees, by reason of higher train speeds, at a time when the earnings of other employees have been stationary, is not the sort of condition to allay mass pressure toward greater equality. Higher train speeds have been the result of the co-operative effort of the entire railway organization and to have their benefits inure so largely to one class only is bound to raise some doubts as to the justice of the *status quo* among those not benefited. For that matter, while to have a locomotive engineer earn, as in Britain, only twice as much as a common laborer, may seem too narrow a spread for the comparative skill and responsibility involved, surely one may doubt, at least from a standpoint of political expediency, whether as wide a spread as that which exists in this country is wise.

As a matter of fact, the desirability—perhaps only from the standpoint of politics—of a narrower range in railway wage scales is recognized in the nature of the wage increase being sought by the non-train unions. This, it will be recalled, is not a percentage increase for each class, which would only serve to widen the spread, but a flat hourly increase for all classes—which would narrow the spread. Aside from the fact that no increase in railway wages is justified under present conditions, even in the interest of the employees themselves, nevertheless the reasoning behind the kind of increase the non-train unions are seeking shows an appreciation of the existence of the kind of situation which gives rise to industrial unions. By contrast, the straight percentage increases being sought by the train and engine

unions, would only serve to make these occupations the more vulnerable if an effort were made at industrial unionization on the railroads.

A second safeguard of craft unionism against competition by the industrial type patently ought to be the eschewing of political methods. The strength of the craft union lies in the strategic economic position of its members, and in driving bargains based upon the strength of that position. When a craft union composed of highly skilled and well paid employees goes before a political body, its strength is quite clearly no greater than that of the voting power of its members. An equivalent number of pants pressers is its equal in every way as far as political strength is concerned. The more frequently that labor disputes which could be settled by collective bargaining are taken to the politicians, therefore, the less is the real strength of the craft position being utilized. Political mass pressure in the place of collective bargaining is slow suicide for the craft union idea—as it is for any idea which assumes that there exist differences in human capacity and human willingness to work, which justify differentials in wages. The vote of the stupid and lazy worker is worth just as much as that of the intelligent and industrious one; and the more political methods are used instead of collective bargaining, the less the skilled and competent workingman will get, over and above those less talented and less deserving.

Thirdly, "full" crew and train limit bills, and other such measures which "make work" for one class of employees at the expense of furloughs for other employees, and lead to a decline in business of the whole industry, and hence employment in it, plainly play right into the hands of those who would organize the industry along industrial lines. As a matter of fact, industrial unionization, if it were not downright revolutionary, might offer some real advantages over craft organization to the industry; because intelligently led industrial unions would not permit employment in the industry as a whole to be sacrificed, as it frequently is under craft organization, for the benefit of but one small group within the industry.

Are Union Dues Too High?

A final consideration (which by no means exhausts the list) of present vulnerability of the railway unions in the face of possible competition from industrial unionization lies in the excessive overhead costs of so many parallel organizations, and the consequent enormous size of union dues and assessments. There has been some recognition of this situation among the railway unions, and competition among them to absorb members of related organizations has resulted. Some attempts at consolidation of unions have been made, but so far without success. Whether "one big union" would protect the interests of the members of the strong railway labor organizations as well as they are now safeguarded may well be doubted. Be that as it may, such protection as the big union would provide, barring flagrant dishonesty or inefficiency, would certainly impose a lower *per capita* burden upon the members for union expenses than that which most of them have now to bear.

The railway labor organizations, by a course which usually has been a conservative one, have won for their members a position at the very forefront of industrial labor anywhere in the world. There is nothing in the record of industrial unionism either here or abroad to indicate that it would do as well for the railway employees who are now organized. At the same time, the present craft unionism has no eternal charter, and champions of an essentially hostile brand of organization have recently made great forward strides in power and prestige. The situation is one which calls for alert and realistic minds. For the continued well-being of the great mass of organized railroaders, we hope, as we trust, that such minds will maintain ascendancy in the standard unions; and that some of the shortcomings of craft organization, which invite competition from rivals, may be quickly "liquidated."

Rail Employment Gains

The preliminary figures of railroad employment in January show that the rate of increase in railroad jobs is continuing at the level reached in the last quarter of 1936. Co-incident with traffic trends, railroad employment last year showed an accelerating upward tendency, the increases over the corresponding months of 1935 amounting to 4.4 per cent in the first quarter of the year, 6.9 per cent in the second quarter, 7.9 per cent in the third quarter, and 9.6 per cent in the last quarter. This same percentage of increase—9.6—was maintained in January.

This meant an increase of 93,800 additional railroad jobs as compared with January a year ago. The principal increases were 13 per cent in the number of train and engine service employees, and 11 per cent in the number of men employed in the maintenance of equipment and stores departments. This year marks the first time since 1932 when more than a million persons have been employed by the railways in January.

From January, 1933, to January, 1937, railroad employment increased by 14 per cent, representing 130,000 additional jobs. The actual and relative increases were as follows: Train and engine service employees, 53,500, or 28.7 per cent; maintenance of equipment and stores employees, 49,600 or 18.9 per cent; maintenance of way and structures employees, 13,500, or 7.4 per cent; transportation employees (other than train and engine service), 9,600 or 7.1 per cent; professional, clerical and general employees, 4,000, or 2.4 per cent. Only one general class of rail employees showed a reduction: From January, 1933, to January, 1937, the number of railway executives, officials and staff assistants declined by 4 per cent.

Steamotive Unit for Turbo-Electric U. P. Locomotive*

Light-weight steam-generating units which respond quickly to wide variations in load have been developed jointly by the General Electric, Babcock & Wilcox, and Bailey Meter Companies

A NUMBER of years ago the General Electric Company considered applying in the power-generation field small steam-generating units of good efficiency, relatively light weight, and small space requirements which would develop from 1,000 to 10,000 hp. It was realized that such a unit should be able to generate steam at high pressures and temperatures, and that steam generation should be controlled automatically in order to respond quickly to wide variations in load. The problem of developing a high-pressure small-capacity boiler was presented to the Babcock & Wilcox Company which undertook to design and construct a complete steam-generating unit suitable for installation in a locomotive with turbo-electric drive installed by the General Electric Company. Control apparatus was developed by the Bailey Meter Company. The complete steam generating unit was developed and called "Steamotive".

Two oil-fired 2,500-hp. Steamotive units, each having a capacity of 40,000 lb. of steam per hr., are now being constructed for the Union Pacific to be used in a double-cab locomotive with a 5,000-hp. rating. These units will furnish steam at 1,500 lb. per sq. in. and 950 deg. F. for driving turbo-generator power units. The locomotive will be used to haul 1,000-ton trains such as the Union Pacific "Challenger" or the "Los Angeles Limited" over the Los Angeles-Omaha route. The locomotive will be streamlined, practically smokeless, and provided with equipment for air conditioning. It is expected that it will attain speeds of 110 m.p.h. on level track. Electric power will drive traction motors constructed on the usual electric-locomotive design.

The objects to be attained in the construction of this complete portable steam power plant are: (1) High steam pressure and temperature; (2) minimum weight and size per unit of steam produced; (3) wide range of capacity with ability of the unit to respond quickly to wide variations in load conditions; (4) adaptability to wide range of fuels; (5) completely co-ordinated auxiliaries; (6) completely co-ordinated automatic control, and (7) simple design, constructed in sizes small enough to be portable.

Following preliminary work done jointly by the Babcock & Wilcox Company, General Electric Company, and Bailey Meter Company to confirm the possibilities, a developmental steam-generating unit was built and put in operation to perfect the design of the various component parts under actual operating conditions. The developmental Steamotive unit was assembled in the General Electric works at Schenectady, New York, during the latter part of 1934. The Steamotive boiler was designed and built by the Babcock & Wilcox Company, at Barberton, Ohio. It was oil-fired and designed for an output of 21,000 lb. of steam per hour at a pressure of 1,500 lb. and a temperature of 1,050 deg. F. leaving the superheater, later changed to 900 deg. F. These specifications conformed to the requirements of a turbine-electric locomotive.

The Steamotive auxiliary set was designed and built by General Electric Company. These auxiliaries, geared together as one turbine-driven unit, consist of a feed pump which delivers 25,000 lb. of water per hour at a pressure of 2,000 lb.; a blower for 30,000 lb. air per hour at a pressure of 60 in. of water; a fuel-oil pump, and a lubricating-oil pump.

The meters and complete automatic control, designed and built by Bailey Meter Company, coordinate the auxiliaries and the supply of fuel, air and feedwater to control steam output, pressure, and temperature, together with complete automatic ignition and safety equipment.

No serious defects were encountered in any of this equipment. During tests the complete unit operated 950 hr., much of which time was continued maximum rating with long periods under extremely variable load conditions, such as would be encountered in regular locomotive road service. The combustion of oil exceeded 400,000 B.t.u per cu. ft. per hr. on peaks and 375,000 B.t.u. under continuous load. The unit operated over a range of output of 10 to 1 under complete automatic control. This Steamotive unit is now in commercial service in the Lynn Works of the General Electric Company.

Installation of Developmental Steamotive Unit

The first developmental Steamotive unit was assembled at the Schenectady Works of the General Electric Company for test. The intention was that two similar units would be installed in the cab of the 5,000-hp. Union Pacific steam-electric locomotive. The shape and di-

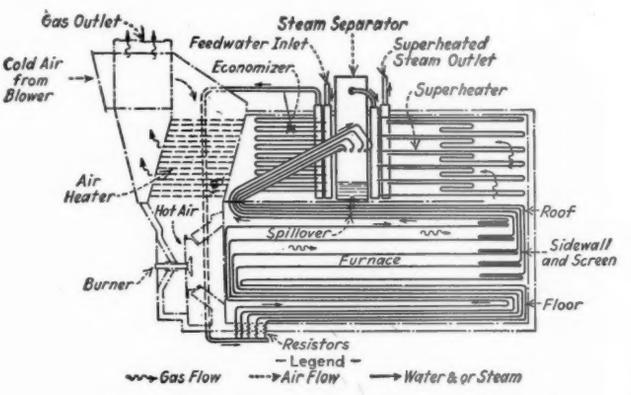


Fig. 1—Flow Diagram of Steamotive Unit

* Abstracted from a paper presented at the Annual Meeting of the American Society of Mechanical Engineers in December, 1936, by E. G. Bailey of the Babcock & Wilcox Company, A. R. Smith of the General Electric Company, and P. S. Dickey of the Bailey Meter Company, and published in the December, 1936, issue of Mechanical Engineering.

mensions of the boiler were determined by the proposed locomotive design, which at that time required the boiler to be wholly above the frame, hence necessitating a horizontal boiler.

The flow diagram of the unit is shown in Fig. 1. From the burner the flame and gases pass horizontally through the completely water-cooled furnace, thence up and back with a 180-deg. turn into the superheater, flowing around the separator, through the economizer and air heater and up the stack. The air for combustion leaves the blower at relatively high pressure, passing through lanes intersecting the stack and down around the air heater tubes to the oil burner. There is no induced draft fan, the blower forcing the air through the burner and furnace under pressure.

The feedwater enters the economizer inlet header, and, after leaving the outlet header, is divided into five circuits, all five of which form the floor, sides, and roof of the furnace as well as the two sets of loops forming the boiler screen. All the steam is generated in these five furnace and boiler circuits, and enters the separator with a surplus of about 400 lb. of water per hr. in each circuit. From the separator the dry steam goes through

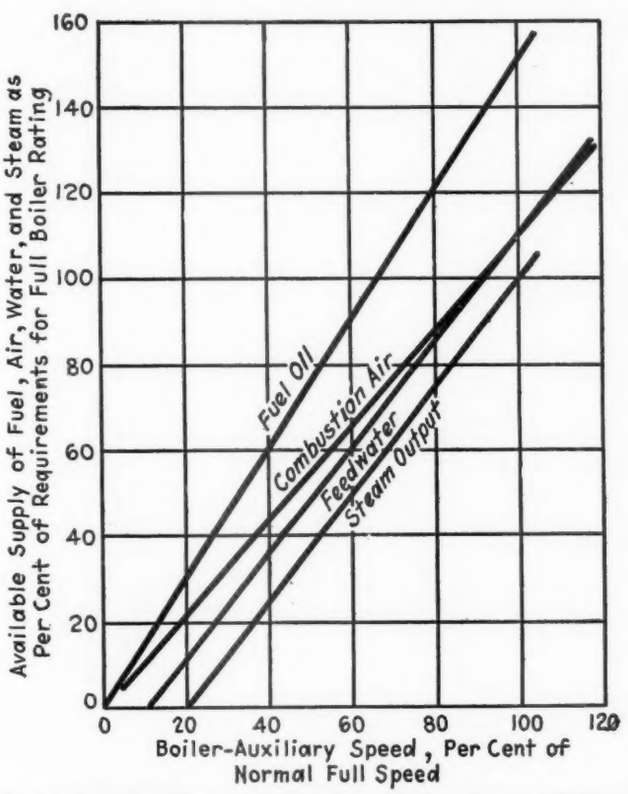


Fig. 2—Characteristics of the Auxiliary Set, Developmental Steamotive Unit

the superheater and directly to the main turbine. The water from the separator is called the "spillover," and it passes through a heat exchanger to the hot well where it mixes with the condensate and is re-fed to the boiler by the feed pump.

Description of the Boiler

The furnace of the Steamotive unit is approximately 3 ft. 6 in. wide, 3 ft. 6 in. high inside the tubes, and 7 ft. 6 in. long from the burner wall to the boiler screen. The furnace volume is 90.4 cu. ft. There are five circuits in parallel in the furnace and boiler screen. The five circuits in the floor, side walls, and roof are connected in

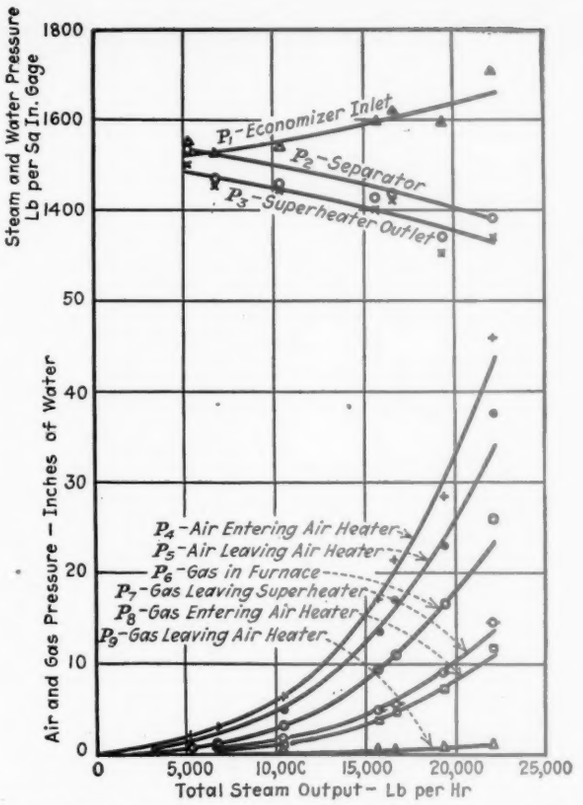


Fig. 3—Air, Gas, Steam, and Water Pressures from Test of Steamotive Unit

such a way as to balance as nearly as possible the heat input to each of the five combined circuits. The length of each floor circuit is 92 ft. 9 in. The average length of each wall circuit is about 183 ft. 6 in., and the average length of each roof circuit is about 49 ft., giving a total average length of each furnace circuit of approximately 325 ft.

The boiler heating surface is as follows: Furnace projected surface, 112.3 sq. ft.; boiler-screen convection surface, 115.9 sq. ft.; super-heater projected radiant surface, 30.5 sq. ft.; superheater convection surface, 127.8 sq. ft.; economizer, 275 sq. ft.; and air heater, 578 sq. ft.

Auxiliary Set

In order to save space and complexity of control, and to improve the efficiency of the boiler auxiliary drive to the highest degree, it was agreed that a combined drive for all the boiler auxiliaries would be an essential feature. These auxiliaries consist of a feedwater pump of the positive displacement type, a blower for furnace combustion air, and a fuel pump of the positive-displacement type. Roughly speaking, the demands for combustion air and fuel oil are proportional to the steam output of the boiler, and in this particular type of boiler the feedwater demand is always in excess of the steam output of the boiler. The characteristics of the various auxiliary requirements are such that the relative speeds of all three auxiliaries should be high for high boiler steam outputs and low for low steam outputs. This makes possible the gearing of the three component parts in a fixed ratio, and driving them by a single variable-speed steam turbine. Thus the entire set runs at a speed determined by the steam output of the boiler with modification to the blower output by means of a damper, and to the fuel-oil output by means of a by-pass on the fuel-oil pump, with the feedwater pump output as the inde-

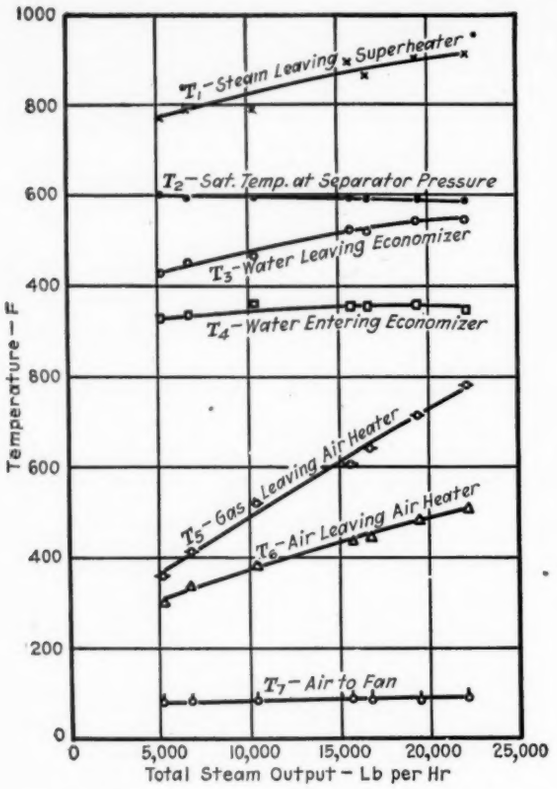


Fig. 4—Air, Gas, Water, and Steam Temperatures from Test of Steamotive Unit

pendent variable from which the speed of the entire set is determined. The relative performance characteristics of the three component parts of the auxiliary set are shown in Fig. 2.

The turbine runs at a relatively high speed, driving a pinion meshing with a high-speed gear on the blower shaft. This same shaft carries the low-speed pinion which meshes with a low-speed gear on the shaft of the boiler feed pump. The fuel-oil pump and the lubricating-oil pump for the set are driven, through a pair of spiral gears, from the outboard end of the shaft of the boiler-feed pump. The turbine for the developmental set is a relatively simple machine of only one stage.

The combustion-air blower is a centrifugal compressor having a maximum discharge head of about 60 in. of water. The boiler feed pump is a single-acting five-cylinder piston pump running at a normal full speed of about 800 r.p.m. with pressure lubrication of the crankshaft pins and connecting rods and crosshead wrist pins.

In view of the limited amount of water and heat storage in Steamotive units and since all natural circulation is eliminated, it is of utmost importance in operating this unit that water be fed as nearly as possible equal to the rate of steam output plus spillover. To accomplish this purpose the speed of the auxiliary set is

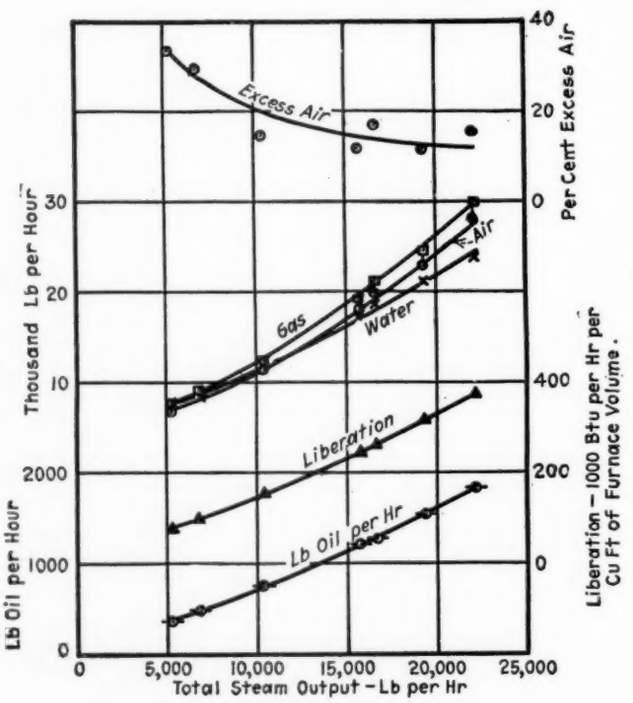


Fig. 5—Air, Fuel, and Steam Requirements from Test of Steamotive Unit

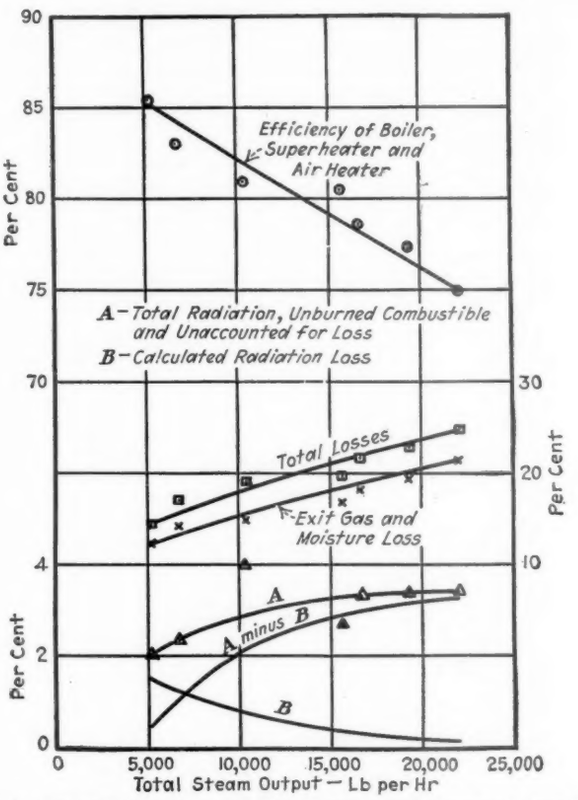


Fig. 6—Boiler Efficiencies and Heat Losses as Determined from Test of Steamotive Unit

governed to maintain any desired water flow from the feed pump.

The desired rate of water flow is established by measured indications of total boiler steam flow and separator drum level, and the variable-water-flow governor regulates the speed of the turbine driving the auxiliary set to maintain this water flow regardless of variations in steam or water pressure, feed-pump efficiency, or other variables.

One of the important principles upon which the Steamotive unit is designed is that of maintaining an excess of water leaving the evaporating furnace circuits. The quantity of this spillover water delivered into the separating drum is maintained constant at all outputs. The excess water flow is secured by means of a fixed-resistance tube connected to the bottom of the separating drum which will discharge the desired quantity of water with a given difference between drum and back pressures. A constant water level in the separating drum is maintained by the automatic control which adjusts feed-

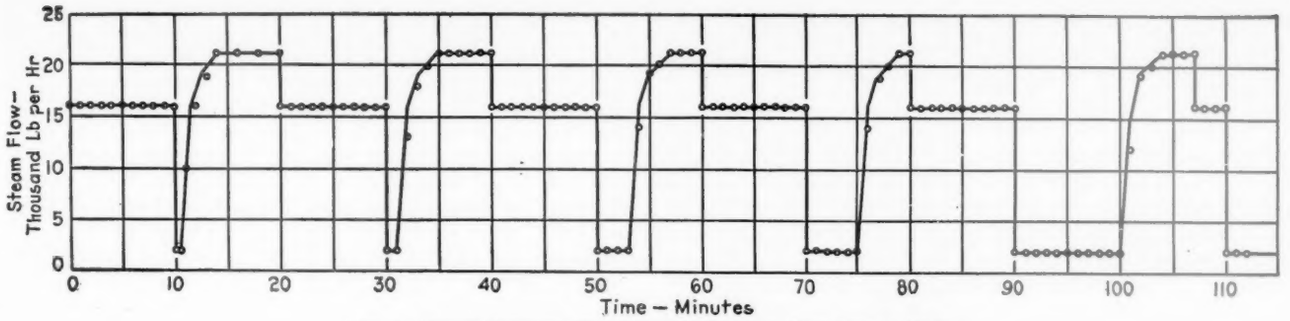


Fig. 7—Steam Demand Placed on Steamotive Unit During Test

pump delivery, which is greater than steam output by the amount of spillover.

The fixed-resistance tube for normal spillover is in parallel with the automatic spillover valve which opens when the water level exceeds the normal limit, quickly bringing the level back to normal by means of the large increase in spillover.

The auxiliary set is designed to provide an excess of air and oil at any given feed-pump speed, and the automatic-control equipment is arranged so that necessary throttling of both is provided to maintain a constant steam pressure at the boiler outlet. In addition, the ratio of fuel and air is closely controlled in accordance with metered indications of each so as to maintain the minimum allowable excess air for good combustion.

The burner is provided with a propane torch with dual spark ignition and with a photoelectric flame indicator. A three-way valve is provided in the oil line to the burner to shut off automatically the fuel oil supply to the burner and recirculate the oil to the suction side of the oil pump. This three-way valve, the solenoid valve in the propane line to the torch, and the spark igniters for the torch are interlocked to perform the following functions: (1) Upon closure of the lighting switch, the igniters are energized and the propane valve opens, lighting the torch. After a short delay, the fuel-oil control valve is opened to the burner, and as soon as ignition of the oil fire is established, as indicated by the photoelectric flame detector, the propane torch and igniters are cut off after a short time delay. (2) The fuel oil is shut off in case of (a) high boiler pressure, (b) high superheat temperature, (c) high temperature at outlet of any furnace circuit, or (d) flame failure. (3) The oil burner is automatically relighted when 2a, 2b, and 2c are restored to normal. (4) Upon loss of flame only, the relighting cycle is repeated several times, and if flame cannot be established, the unit is shut down, requiring manual reset. (5) Upon loss of feed-pump suction pressure or loss of lubricating-oil pressure for the auxiliary set the oil fire and torch are cut off and the air supply to the governor of the auxiliary-set turbine is likewise cut off, shutting down the auxiliary set.

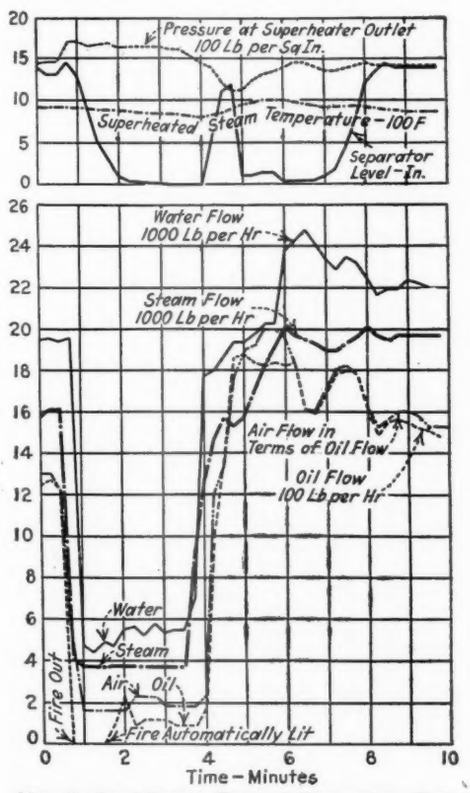


Fig. 8—Load-Swing Test of Steamotive Unit Which Simulates a Station Stop Made By a Locomotive

Test Results

Heat-balance data obtained from final tests are given in Figs. 3, 4, 5 and 6. Before the tests were begun there was some apprehension about being able to reach the desired capacity of 21,000 lb. of steam per. hour with any reasonable combustion efficiency. Although the design capacity for continuous running was for 16,000 lb. of steam per hour, the unit ran 40 continuous hours at 21,000 lb. per hour and was tested up to 22,000 lb. per hour, which was the limit of the blower for continuous operation.

At the normal load rate of 16,000 lb. of steam per hour the feed-water pressure entering the economizer was 1,610 lb. and the steam pressure at the superheater outlet was 1,390 lb., there being a 220-lb. pressure drop through the economizer, boiler, and superheater. The steam temperature leaving the superheater at an output of 16,000 lb. per hour is 870 deg. F., rising to 910 deg. F. at 22,000 lb. per hour and dropping to 770 deg. F. at 5,000 lb. per hour.

The air pressure entering the air heater is 18 in. of water at a steaming rate of 16,000 lb. per hour, which increases to 43 in. at a rate of 22,000 lb. per hour. The air entering the burner is 450 deg. F. at a rate of 16,000 lb. per hour, and 500 deg. F. at a rate of 22,000 lb. per hour. Combustion is complete within this range of output with less than 15 per cent excess air and with combustion rates from 25,000 to 375,000 B. t. u. per cu. ft. of furnace volume per hour.

The boiler efficiency varies from 75 per cent based on the high heat value at a rate of 22,000 lb. per hour up to 85.5 per cent at a rate of 5,000 lb. per hour. These efficiencies are 4 to 5 per cent higher than those originally anticipated from the limited heating surface permitted under the conditions to be met in locomotive design.

Fig. 7 shows the type of load-cycling tests which were

made on the unit to determine its suitability for performance on a high-speed locomotive. The solid line on the curve indicates the desired load cycle and the plotted points show the actual ratings reached by the boiler at each particular time.

The load-cycle tests on the unit were in two periods of 80 and 267 hours duration. Approximately 450 cycles from minimum to maximum load were made. The total operating time of the unit at Schenectady was 950 hr.

Fig. 8 shows results of a typical test made to determine the flexibility of this unit. This simulates a station stop of a locomotive, when the steam flow, except for driving the auxiliary set, is quickly shut off. The unit continues at a low load for three minutes when the throttle is opened, increasing the steam flow to approximately 16,000 lb. per hr. in one minute and to 20,000 lb. per hr. in 2½ min. The effect of these load changes upon steam pressure, steam temperature, water level in the separating drum, water flow, air flow, and oil flow are clearly shown.

During these load-cycle tests, such as shown in Fig. 9, oil was burned at rates well above the maximum output rate for short periods during the load pickup, and during some of these periods the liberation was as high as 500,000 B.t.u. per cu. ft. of furnace volume per hour with low excess air, complete combustion, and freedom from smoke.

The boiler can be placed in service quickly from a completely cold condition, but the auxiliary set must be driven from an external source. The boiler can be made to steam at reduced pressure within four minutes, and up to full load at normal pressure and temperature after six minutes more.

Comparative Labor Standards in Transport

WASHINGTON, D. C.

POINTING out how difficult it is, under any circumstances, to draw convincing comparisons with respect to the question of employee compensation where conditions vary so greatly as they do from one branch of the transport industry to another, Dr. Charles S. Morgan, director of former Co-ordinator Eastman's Section of Research, has submitted to the latter a report on comparative labor standards in transportation. The report, a 147-page document, is the last of a series of labor studies made under the former co-ordinator's direction. The three previous studies dealt in turn with hours, wages and working conditions in scheduled air transportation, domestic water transportation and intercity motor transport.

In making public the present report Mr. Eastman called it an endeavor "to bring together the more essential facts developed in the underlying reports, supplementing them with facts in regard to pipe line and railroad transportation, and to make such comparisons of labor standards in the various branches of the transportation industry as can fairly be made on the data available."

Accompanying the report was Dr. Morgan's letter of transmittal which was devoted in the main to the summarizing of his findings. This letter included the following:

The accompanying report endeavors to bring together the more essential facts developed in the underlying reports, variously supplemented, and to offer such indications as to how labor standards in the transportation industries compare as are warranted by the nature of the subject matter and the data which it was practicable to gather. Whatever contribution the report makes lies in large part in another direction, that of showing how difficult it is, under any circumstances, to draw convincing comparisons with respect to the vital question of employee compensation where conditions vary so greatly as they do from one branch of transportation to another.

The underlying studies were directed solely at fact-finding, with the objective of determining whether or to what extent differences in labor standards were a disturbing element within any one of the several branches of transportation and a threat to other branches or to the welfare of transportation workers generally, and how far conditions were present which affected the public safety. Conditions have changed and improved in many respects since the studies were undertaken. To this improvement both economic forces and legislation have contributed.

In 1934, approximately 1,775,500 persons on the average earned their livelihood in the transportation field. Of these workers, 60.1 per cent were employed by steam railroads, 16.5 per cent by carriers by water (domestic and foreign operations), 15.4 per cent by intercity motor truck operators, 2.0 per cent by intercity motor bus operators, 2.0 per cent by express companies, 1.5 per cent by pipe lines (petroleum and petroleum products), 1.1 per cent by electric railways subject to the Interstate Commerce Act, 1.1 per cent by the Pullman Company, and 0.3 per cent by scheduled air transport operators.

A description of the labor force in each branch of transportation serves to indicate how varied are the occupational skills and responsibilities from one field of transportation to another and to emphasize the fact that direct comparisons of compensation, where possible, must be made with circumspection.

Certain conclusions stand out fairly clearly with respect to hours of work. Pipe lines now observe for most workers a 36-hour week, by far the shortest work-week generally observed by a single branch of transportation. Other forms of transportation have short-hour groups, but in each case special factors enter in which tend to lessen the significance of these cases in a consideration of comparative labor standards. On the other hand, excepting pipe lines, each form of transportation has groups of workers whose hours exceed those which have come to be regarded as "standard" in many branches of industry—8 per day and 48 per week. In the case of railroads, from 10 to 12 per cent of all workers (omitting executives) regularly work over 48 hours per week, though only 3 per cent are scheduled for more than 56 and 1 per cent for more than 72 hours. In the field of water transportation, voluntary action of employers, legislation and union activities have produced a shortening of hours in recent years, but substantially all vessel personnel puts in more than a 48-hour week.

In July, 1933, 44 per cent of the ground personnel of airlines worked 50 hours or more, but less than 1 per cent, 60 hours and over. Somewhat shorter hours are observed today.

For the same month a field survey indicated the following with respect to the actual hours worked in motor transportation:

	Percent working		
	52 hours and over	60 hours and over	72 hours and over
Regular intercity drivers:			
Bus	48	23	5
Truck	53	31	7
Maintenance forces:			
Bus	63	27	3
Truck	55	31	5
Station and office:			
Bus	44	22	2
Truck	39	22	2
All employees:			
Bus	52	24	4
Truck	47	27	5

While conditions in bus and truck transportation have improved, as indicated by appreciably lower average hours in most cases in October, 1935, when a second field survey was made, it is to be noted that the data cited above relate for the most part to better than average conditions. Particularly is such the case with respect to motor truck transportation, where practices which involve extremely long hours are not uncommon.

The foregoing evidence indicates that there are substantial differences in the extent of long hours in the several forms of

(*Continued on page 504*)

Agreement Reached on Pensions

Roads and labor join in seeking legislation to supersede present contested acts — Wage tax starts at 2½ per cent

PENSIONS for railway employees when they reach 65 (or, with certain limitations, at an earlier age) are provided for in an agreement announced on March 16 by President J. J. Pelley of the Association of American Railroads and George M. Harrison, chairman of the Railway Labor Executives Association. According to the announcement, "complete agreement" has been reached between the managements and the 21 standard railroad unions. To give effect to the agreement, it will be necessary for Congress to pass two acts, which the roads and the unions join in requesting—one amending the present Railroad Retirement Act and the other, a substitute for the Railway Tax Act (now enjoined by the federal district court of the District of Columbia) which was to have expired February 28 last, but which was extended recently by Congress to the end of the fiscal year 1938. Prompt passage of the legislation may be delayed because of the attitude of the U. S. Treasury Department which has questioned the adequacy of the proposed tax rates.

Collective Bargaining Succeeds Where Politics Fail

Thus collective bargaining has achieved, in a little more than two months of negotiation, a goal which railway employees—and latterly the railway labor organizations—have tried vainly to reach for many years by the employment of political methods. The benefits to be paid to retired employees are computed on the same basis as under the present Railroad Retirement Act, with a maximum monthly payment of $120. Under the agreement the new pension plan will include present railway pensioners (roughly estimated at about 55,000). An approximation of the number of present employees who would be immediately entitled to retirement provided the proposed legislation is enacted is given at about 50,000—although that is no gage of the number which may actually retire, since a considerable latitude is permitted in continuing employment beyond 65, as well as in retirement before that age. The principal points in the plan follow:

Summary of Plan

1. Provides for a total tax of 5 per cent of the payroll, not in excess of $300 for any one month for any employee, to be paid into the United States Treasury. This tax increases gradually, to a maximum of 7 per cent after 12 years. One-half of the tax will be paid by the railroads and the other half by the employees. The rate in the existing Railway Tax Act was 7 per cent, equally divided.
2. All annuities are to be paid out of the United States Treasury.
3. Plan is to be administered by the Railroad Retirement Board as now provided.
4. Method of computing amount of annuity to be paid retired employees is the same under the plan as now incorporated in the Railroad Retirement Act.
5. An employee is eligible to retire voluntarily upon attaining the age of 65 years, but may retire at 60 years of age after completing 30 years of service with a reduction in the annuity at the rate of one-fifteenth for each year he is under 65.
6. An employee can continue to work after attaining 65 years of age but must continue to pay the tax, although he will not be credited with any service earned by such employment after July 1, 1937.
7. Plan permits retirement of employees because of physical or mental disability after 30 years of service with full annuity privileges.
8. Present pension rolls of the railroads are taken over under the plan.
9. No annuity will be paid to any employee who retires and engages in "regular gainful employment" in some other line of work.
10. Provides for death benefits for a deceased employee's estate.
11. The plan affects approximately 1,500,000 employees of railroad associations and of railroad labor organizations, are also included. Further details of the plan are set forth in the statement of Messrs. Pelley and Harrison as follows:

Retirement at 65 Not Compulsory

The plan provides for voluntary retirement at 65, this being at the election of the employee. There is no compulsory retirement age in the Act, but any employee who continues to work beyond the age of 65 will receive no credit for service after 65. If a man has 30 years of service and has reached the age of 60, he may retire, but in that case there is a cut-back of one-fifteenth for each year the employee is under 65. Persons who are totally disabled are eligible to retire if they have completed 30 years of service. Any man who reaches 65 may retire and secure an annuity based on his years of service even though he is not in railroad service when he reaches the age of 65. No one is entitled to an annuity unless he was in an employment relation on or after August 29, 1935, the enactment date of the Act to which the proposed Act is amendatory.

How Payments Are Computed

The amount of the annuity is determined by multiplying the years of service by a certain percentage of the monthly compensation up to $300. This percentage on the compensation, as in the present law, is 2 per cent on the first $50, 1½ per cent on the next $100, and 1 per cent on all sums over $150, up to the $300 maximum. The compensation is determined by the average monthly compensation earned by an employee so far as the service is rendered after January 1, 1937. However, the employee is entitled to have 30 years of service considered if he has worked that long. In the case of an employee who has less than 30 years of service after January 1, 1937, there is to be added the years of service in reverse order prior to January 1, 1937, in an amount sufficient to make 30. As to the years of service counted prior to January 1, 1937, the actual earnings are not necessarily taken, but the compensation is that of a test period, which includes the years 1924 to 1931, inclusive, with a provision, however, that if an employee did not work in the test period, or if for any reason that period proves to be unfair, the Railroad Retirement Board may adopt such a basis of compensation as is fair and equitable.

The plan provides for a minimum annuity for persons who have had at least 20 years of service, the minimum being related

to the monthly compensation according to a graduated scale of percentages. In no event, however, can the annuity be less than the old-age benefit that the employee would receive under the Social Security Act if his service after December 31, 1936, were included in the term "employment" as defined in the Social Security Act.

A Break for the Missus, If Employee Wants It

The plan provides for a joint and survivor annuity under which, if the employee so elects, he will be paid a part of his normal annuity when he retires, the balance to be used to purchase an annuity for his wife if she survives him. Death benefits are provided for persons who were employees after December 31, 1936. Under this provision, if the employee dies there will be paid to his heirs or estate four percent of all wages earned by him up to $300 in any one month after December 31, 1936.

The plan provides that, effective July 1, 1937, all persons on railroad pension rolls as of March 1, 1937, shall come under the retirement plan and thereafter be paid such pensions as the private pension plan of the carrier provided, not, however, in excess of $120 for any one month. Where a retired employee is now receiving a larger pension than $120, the railroad agrees to make up the difference.

The plan, just as the existing Act, creates a Retirement Board of three members to be appointed by the President subject to confirmation of the Senate. Each member receives $10,000 per year and holds office for five years. One member shall be appointed by the President upon the nomination of employees and another upon the nomination of the railroads. The other member shall be appointed by the President without suggestions from any of the interested parties. The Retirement Board shall administer the Act, pass upon pension applications, certify them to the Treasury, make rules and regulations for the administration of the Act, and may call upon the railroads for information in railroad records.

Social Security Act Superseded

All persons subject to the Railroad Retirement Act are excluded from the Federal old-age tax and benefit provisions of the Social Security Act. The proposed substitute for the present Railway Tax Act would impose an income tax on the wages of employees earned subsequent to December 31, 1936, upon the following basis: 2½ per cent for the years 1937, 1938 and 1939, 2¾ per cent for the years 1940, 1941 and 1942, 3 per cent for the years 1943, 1944 and 1945, 3¼ per cent for the years 1946, 1947 and 1948, 3½ per cent after December 31, 1948.

The proposed Act also provides for an excise tax on the employers, payable on amounts paid to employees subsequent to December 31, 1936, upon the same percentages and with the same step-up as applies to the wages of employees. In neither case is an amount in excess of $300 per month to be taken into consideration.

The proposed substitute Tax Act would repeal the present Railway Tax Act and under the agreement all money held by the railroads in the form of deductions from the wages of employees prior to January 1, 1937, would be returned to the employees and all amounts set aside in any way by the railroads for the payment of their excise taxes would be abated. As to the period subsequent to December 31, 1936, the railroads would retain and pay into the Treasury 2½ per cent on the payroll, return 1 per cent to the employees, and pay into the Treasury their own 2½ per cent excise tax upon the payroll.

It was agreed that litigation originally instituted by the railroads now pending in the Circuit Court of Appeals for the District of Columbia involving the validity of the Railroad Retirement Act and the Railroad Tax Act shall, subject to the approval of the Attorney General, be disposed of in such manner as to carry out the purposes of this agreement.

The representatives of the railway labor organizations and the railroads who conducted the negotiations were as follows:

For the employees: B. M. Jewell, Railway Employees Department, A. F. of L.; J. A. Phillips, Order of Railway Conductors; E. J. Manion, Order of Railway Telegraphers; James J. Delaney, president, Masters, Mates and Pilots of America; Geo. M. Harrison, chairman, Railway Labor Executives' Association.

For the railroads: M. W. Clement, president, Pennsylvania; C. R. Gray, president, Union Pacific; J. B. Hill, president, Lousiville & Nashville; C. E. Denney, president, Erie; H. A. Scandrett, trustee, Chicago, Milwaukee, St. Paul & Pacific; L. A. Downs, president, Illinois Central; J. J. Pelley, resident, Association of American Railroads.

Freight Car Loading

WASHINGTON, D. C.

REVENUE freight car loading for the week ended March 6 totaled 734,127 cars, an increase of 37,400 cars or 5.4 per cent above the preceding week which contained Washington's birthday holiday, an increase of 99,557 cars or 15.7 per cent above the corresponding week in 1936, and an increase of 146,937 cars or 25 per cent above the corresponding week in 1935. All commodity classifications except ore showed increases over the preceding week, and all commodity classifications except grain showed increases over last year. The summary, as compiled by the Car Service Division of the Association of American Railroads, follows:

Revenue Freight Car Loading

For Week Ended Saturday, March 6

Districts	1937	1936	1935
Eastern	168,059	138,583	134,761
Allegheny	154,540	121,799	118,090
Pocahontas	56,918	49,719	46,884
Southern	113,678	101,821	91,591
Northwestern	80,102	75,180	66,563
Central Western	104,855	94,529	82,729
Southwestern	55,975	52,939	46,572
Total Western Districts	240,932	222,648	195,864
Total All Roads	734,127	634,570	587,190
Commodities			
Grain and Grain Products	28,671	36,960	26,975
Live Stock	11,448	11,166	11,684
Coal	159,196	133,195	129,938
Coke	12,019	8,206	6,750
Forest Products	36,420	30,765	24,435
Ore	10,664	6,453	4,431
Merchandise L.C.L.	170,872	159,113	159,906
Miscellaneous	304,837	248,712	223,071
March 6	734,127	634,570	587,190
February 27	696,727	672,869	604,331
February 20	714,884	586,487	553,165
February 13	691,618	631,095	581,669
February 6	675,026	621,686	591,327
Cumulative Total, 10 Weeks	6,829,268	6,121,260	5,683,789

Car Loading in Canada

Car loadings in Canada for the week ended March 6 totaled 47,345, as compared with 46,646 in the preceding week, according to the summary by the Dominian Bureau of Statistics. The increase over last year was 2,082.

Total for Canada:	Total Cars Loaded	Total Cars Rec'd from Connections
February 27, 1937	46,646	28,716
March 6, 1937	47,345	30,083
February 20, 1937	46,689	28,137
February 29, 1936	45,263	24,730
Cumulative Totals for Canada:		
March 6, 1937	418,564	247,935
February 29, 1936	366,917	199,598
March 2, 1935	383,151	200,426

1936 Net Income $169,900,578

WASHINGTON, D. C.

NET income of $169,900,578 was reported by Class I railroads for 1936, according to the Interstate Commerce Commission's compilation of selected income and balance-sheet items. This compares with a 1935 deficit of $1,374,094. Net railway operating income last year was $667,234,256 as compared with $499,001,617 in 1935. Fixed charges were down from a 1935 total of $640,395,122 to $633,855,393 last year.

The commission's summary and the principal items for the individual roads are shown in the accompanying tables.

Selected Income and Balance-Sheet Items of Class I Steam Railways

Compiled from 138 Reports (Form IBS) Representing 144 Steam Railways
TOTALS FOR THE UNITED STATES (ALL REGIONS)

For the month of December 1936	For the month of December 1935	*Income Items*	For the twelve months of 1936	For the twelve months of 1935
[1]$70,496,657	$46,020,700	1. Net railway operating income	[1]$667,234,256	$499,001,617
[1]37,622,998	34,276,635	2. Other income	[1]169,852,168	171,211,606
108,119,655	80,297,335	3. Total income	837,086,424	670,213,223
2,842,960	3,392,562	4. Miscellaneous deductions from income	21,212,371	19,162,113
105,276,695	76,904,773	5. Income available for fixed charges	815,874,053	651,051,110
		6. Fixed charges:		
11,295,245	11,580,588	6-01. Rent for leased roads	134,272,151	135,063,069
42,980,129	42,442,863	6-02. Interest deductions	496,830,881	502,720,095
253,832	221,523	6-03. Other deductions	2,752,361	2,611,958
54,529,206	54,244,974	6-04. Total fixed charges	633,855,393	640,395,122
50,747,489	22,659,799	7. Income after fixed charges	182,018,660	10,655,988
1,069,531	1,011,531	8. Contingent charges	12,118,082	12,030,082
49,677,958	21,648,268	9. Net income[2]	169,900,578	[3]*1,374,094
16,133,015	15,866,872	10. Depreciation (Way and structures and Equipment)	193,514,080	194,686,221
3,086,146	1,725,849	11. Federal income taxes	30,247,029	18,901,542
		12. Dividend appropriations:		
42,572,618	22,904,794	12-01. On common stock	142,270,112	108,234,443
1,244,447	3,497,688	12-02. On preferred stock	27,562,398	17,544,112

Selected Asset Items	Balance at end of December 1936	Balance at end of December 1935
13. Investments in stocks, bonds, etc., other than those of affiliated companies (Total, Account 707)	$681,022,849	$735,426,595
14. Cash	529,648,719	408,581,546
15. Demand loans and deposits	6,670,342	4,716,467
16. Time drafts and deposits	43,820,840	26,044,585
17. Special deposits	93,575,408	81,564,809
18. Loans and bills receivable	2,572,117	2,866,322
19. Traffic and car-service balances receivable	76,411,312	59,852,169
20. Net balance receivable from agents and conductors	51,470,784	43,063,825
21. Miscellaneous accounts receivable	148,882,156	138,514,416
22. Materials and supplies	307,574,520	279,919,122
23. Interest and dividends receivable	22,612,686	28,372,607
24. Rents receivable	1,572,259	2,188,704
25. Other current assets	6,546,015	5,485,806
26. Total current assets (items 14 to 25)	$1,291,357,158	$1,081,170,378
Selected Liability Items		
27. Funded debt maturing within 6 months[4]	$172,689,429	$330,944,204
28. Loans and bills payable[5]	211,890,168	313,741,127
29. Traffic and car-service balances payable	95,160,977	75,196,560
30. Audited accounts and wages payable	228,167,318	213,399,038
31. Miscellaneous accounts payable	116,590,259	64,285,578
32. Interest matured unpaid	559,443,744	441,378,895
33. Dividends matured unpaid	12,502,905	13,747,520
34. Funded debt matured unpaid	475,215,803	370,708,470
35. Unmatured dividends declared	5,654,953	9,266,521
36. Unmatured interest accrued	91,809,350	90,641,600
37. Unmatured rents accrued	22,619,341	24,658,652
38. Other current liabilities	30,460,253	20,483,676
39. Total current liabilities (items 28 to 38)	$1,849,515,071	$1,637,507,637
40. Tax liability (Account 771):		
40-01. U. S. Government taxes	$107,485,356	$36,129,185
40-02. Other than U. S. Government taxes	133,164,947	121,381,039

* Deficit or other reverse items.

[1] Net railway operating income was increased approximately $2,719,000 during last six months of 1936 and "Other income" reduced about the same amount as the result of a contract effective July 1, 1936, requiring Pacific Fruit Express Co. to reimburse the Southern Pacific Transportation System and the Union Pacific R. R. Co. for certain services which under the previous contract were furnished without charge.

[2] The net income as reported includes charges of $2,041,398 for December, 1936, and $18,253,153 for the twelve months of 1936 on account of accruals for excise taxes levied under the Social Security Act of 1935; also $11,028,700 for December, 1936, and $47,298,556 for the twelve months of 1936 under the requirements of an Act approved August 29, 1935, levying an excise tax upon carriers and an income tax upon their employees, and for other purposes. The net income for the month of December and the twelve months ended with December, 1935, was reduced by $5,277,177 charged to operating expenses by the Illinois Central R. R. and the Yazoo & Mississippi Valley R. R. on account of equipment repairs made in 1934. Reversal of charges previously made for liability under the Railroad Retirement Act of 1934 increased the net income for December, 1935, by $373,549 and for the twelve months ended with December, 1935, by $9,003,287.

[3] This figure is $8,912,221 less than the net income shown in Statement No. 33 in Statistics of Railways for 1935 due principally to the fact that returns for the Southern Pacific Company and the Texas and New Orleans Railroad Company are included in Statement No. 33 on an individual road basis and in this statement on a system basis. Figures for 1935 and 1936 are comparable in this statement.

[4] Includes payments which will become due on account of principal of long-term debt (other than that in Account 764, Funded debt matured unpaid) within six months after close of month of report.

[5] Includes obligations which mature not more than 2 years after date of issue.

Selected Income Items by Regions and Districts, Class I Steam Railways, Calendar Years 1936 and 1935

Region and Railway	Net Railway Operating Income 1936	Net Railway Operating Income 1935	Total Income 1936	Total Income 1935	Total Deductions 1936	Total Deductions 1935	Net Income 1936	Net Income 1935
Eastern District:								
New England Region	$15,689,792	$18,389,642	$24,116,250	$29,353,571	$30,297,937	$32,962,229	*$6,181,687	*$3,608,658
Great Lakes Region	116,599,661	89,780,614	151,540,596	122,379,956	123,788,648	124,617,735	27,751,948	*2,237,779
Central Eastern Region	156,684,893	126,868,327	208,280,794	176,860,228	150,562,435	150,753,172	57,718,359	26,107,056
Total, Eastern District	288,974,346	235,038,583	383,937,640	328,593,755	304,649,020	308,333,136	79,288,620	20,260,619
Southern District:								
Pocahontas Region	97,155,628	74,857,221	101,859,714	79,740,456	17,876,864	18,796,091	83,982,850	60,944,365
Southern Region	80,146,408	[1]49,302,230	94,123,894	[1]58,432,019	83,379,928	83,167,987	10,743,966	[1]/*24,735,968
Total, Southern District	177,302,036	[1]124,159,451	195,983,608	[1]138,172,475	101,256,792	101,964,078	94,726,816	[1]36,208,397
Western District:								
Northwestern Region	66,709,179	48,874,812	82,184,705	65,483,870	97,051,259	97,188,177	*14,866,554	*31,704,307
Central Western Region	[2]98,418,866	70,093,402	133,918,837	113,517,833	104,569,823	104,506,679	29,349,014	9,011,154
Southwestern Region[3]	35,829,829	20,835,369	41,061,634	24,445,290	59,658,952	59,595,247	*18,597,318	*35,149,957
Total, Western District	[2]200,957,874	139,803,583	257,165,176	203,446,993	261,280,034	261,290,103	*4,114,858	*57,843,110
United States	[2]667,234,256	[1]499,001,617	837,086,424	[1]670,213,223	667,185,846	671,587,317	169,900,578	[1]/[4]/*1,374,094

* Deficit or other reverse items.

[1] Reduced by $5,277,177 charged to operating expenses in December, 1935, by the Illinois Central R. R. and the Yazoo & Mississippi Valley R. R. on account of equipment repairs made in 1934.

[2] Net railway operating income was increased approximately $2,719,000 during last six months of 1936 and "Other income" reduced about the same amount as the result of a contract effective July 1, 1936, requiring Pacific Fruit Express Co. to reimburse the Southern Pacific Transportation System and the Union Pacific R. R. Co. for certain services which under the previous contract were furnished without charge.

[3] Does not include Texas & New Orleans, the income items of which are included in returns made by Southern Pacific Transportation System in Central Western Region.

[4] This figure is $8,912,221 less than the net income shown in Statement No. 33 in Statistics of Railways for 1935, due principally to the fact that returns for the Southern Pacific Company and the Texas & New Orleans Railroad Company are included in Statement No. 33 on an individual road basis and in this statement on a system basis. Figures for 1935 and 1936 are comparable in this statement.

Selected Income Items by Regions and Districts, Class I Steam Railways, 1936 and 1935—Continued

Region and Railway	Net Railway Operating Income		Total Income		Total Deductions		Net Income	
	1936	1935	1936	1935	1936	1935	1936	1935
Akron, Canton & Youngstown Ry.‡	$483,150	$383,048	$576,117	$526,524	$373,556	$282,501	$202,561	$244,023
Atchison, Topeka & Santa Fe Ry.[5]	18,501,904	15,703,352	23,346,246	22,749,966	13,348,120	13,195,651	9,998,126	9,554,315
Atlantic Coast Line System:								
Atlanta & West Point R. R.	*4,946	*50,302	18,258	*25,994	4,296	604	13,962	*26,598
Atlanta, Birmingham & Coast R. R.	*14,665	*83,294	12,851	*50,435	21,817	25,257	*8,966	*75,692
Atlantic Coast Line R. R.	4,415,754	2,578,763	9,248,183	5,023,756	7,333,028	7,553,211	1,915,155	*2,529,455
Charleston & Western Carolina Ry.	445,727	326,335	470,069	350,655	302,642	302,929	167,427	47,726
Clinchfield R. R.	2,575,949	2,047,003	2,616,598	2,559,269	2,616,598	2,559,269	.....	.....
Georgia R. R.—Lessee Organization	676,172	512,891	711,102	544,881	692,009	697,711	19,093	*152,830
Louisville & Nashville R. R.	19,257,364	13,961,959	20,172,409	14,787,082	10,543,937	10,658,139	9,628,472	4,128,943
Nashville, Chattanooga & St. Louis Ry.	1,382,842	523,010	1,610,295	755,305	1,558,296	1,546,765	51,999	*791,460
Western Ry. of Alabama	50,732	*48,447	94,135	*6,964	74,946	70,187	19,189	*77,151
Baltimore & Ohio System:								
Alton R. R.	777,709	*416,226	882,575	*319,572	1,827,367	1,822,596	*944,792	*2,142,168
Baltimore & Ohio R. R.	30,185,305	24,184,984	39,307,070	31,596,850	34,768,095	34,777,758	4,538,975	*3,180,908
Staten Island Rapid Transit Ry.	*446,201	*507,611	487,262	485,037	487,262	485,037	.....	.....
Bangor & Aroostook R. R.	1,433,308	1,593,512	1,476,728	1,635,791	729,477	762,038	747,251	873,753
Bessemer & Lake Erie R. R.	6,838,320	2,984,691	7,046,593	3,166,256	1,539,432	1,162,760	5,507,161	2,003,496
Boston & Maine R. R.	4,853,186	6,617,918	5,982,116	7,770,154	7,636,299	7,563,389	*1,654,183	206,765
Burlington-Rock Island R. R.	*276,424	*326,628	*271,036	*305,053	750,813	751,497	*1,021,849	*1,056,550
Burlington Route:								
Chicago, Burlington & Quincy R. R.	13,448,827	10,228,355	14,743,177	11,309,248	9,586,013	9,466,405	5,157,164	1,842,843
Colorado & Southern Ry.	598,589	349,353	2,101,534	3,366,474	2,078,945	2,152,502	22,589	1,213,972
Fort Worth & Denver City Ry.	1,211,572	1,180,639	1,272,876	1,268,559	1,247,025	1,306,971	25,851	*38,412
Cambria & Indiana R. R.	838,090	838,052	855,044	859,342	66,354	110,176	788,690	749,166
Canadian National System:								
Canadian National Lines in New England	*660,070	*714,244	637,056	703,148	637,761	672,438	*705	30,710
Central Vermont Ry.	*194,268	453,304	*160,671	549,188	1,299,601	1,338,844	*1,460,272	*789,656
Duluth, Winnipeg & Pacific Ry.	*1,811	*141,977	494,995	481,059	482,445	481,142	12,550	*83
Grand Trunk Western R. R.	2,670,053	2,607,233	3,607,709	3,252,398	4,018,831	3,544,185	*411,122	*291,787
Canadian Pacific System:								
Canadian Pacific Lines in Vermont	*574,287	*488,489	263,969	264,066	263,969	264,066	.....	.....
Duluth, South Shore & Atlantic Ry.	637,194	369,590	669,038	386,132	965,222	945,953	*296,184	*559,821
International Ry. Co. of Maine	*159,589	*179,768	146,580	146,580	146,580	146,580	.....	.....
Minneapolis, St. Paul & Sault Ste. Marie Ry.	2,005,932	1,478,904	2,347,859	1,569,662	7,909,711	6,794,009	*5,561,852	*5,224,347
Spokane International Ry.‡	103,870	*18,887	110,135	*13,583	274,372	274,422	*164,237	*288,005
Chesapeake & Ohio Ry.	52,734,863	39,937,282	54,212,590	40,949,005	10,422,587	9,909,520	43,790,003	31,039,485
Chicago & Eastern Illinois Ry.‡	1,658,301	622,754	1,927,896	803,680	2,263,286	2,273,927	*335,390	*1,470,247
Chicago & Illinois Midland Ry.	1,168,008	820,030	1,178,150	825,629	522,357	645,994	655,793	179,635
Chicago & North Western System:								
Chicago & North Western Ry.‡	5,260,641	3,578,484	7,070,096	5,951,939	16,744,101	17,022,287	*9,674,005	*11,070,348
Chicago, St. Paul, Minneapolis & Omaha Ry.	427,646	175,578	497,086	246,479	2,520,419	2,549,187	*2,023,333	*2,302,708
Chicago Great Western R. R.‡	2,197,924	1,307,386	2,322,879	1,432,977	1,951,126	1,951,229	371,753	*518,252
Chicago, Indianapolis & Louisville Ry.‡	500,440	210,703	606,989	231,691	1,539,183	1,546,156	*932,194	*1,314,465
Chicago, Milwaukee, St. Paul & Pacific R. R.‡	9,461,358	4,723,983	10,920,938	6,122,334	24,117,046	24,131,082	*13,196,108	*18,008,748
Columbus & Greenville Ry.	109,895	64,944	128,074	84,642	18,815	21,610	109,259	63,032
Delaware & Hudson R. R.	3,163,583	1,361,885	3,360,838	1,550,894	4,287,533	4,325,871	*926,695	*2,774,977
Delaware, Lackawanna & Western R. R.	6,362,518	3,587,608	7,640,087	4,736,666	7,772,934	7,668,971	*132,847	*2,932,305
Denver & Rio Grande Western R. R.‡	1,569,815	2,417,975	1,909,723	2,719,978	5,956,163	5,988,776	*4,046,440	*3,268,798
Denver & Salt Lake Ry.	1,090,810	1,260,698	1,115,222	1,327,018	1,112,767	1,237,191	2,455	89,827
Detroit & Mackinac Ry.	130,742	63,544	133,384	66,239	121,367	119,399	12,017	*53,160
Detroit & Toledo Shore Line R. R.	1,131,537	1,037,662	1,145,650	1,051,771	124,532	121,106	1,021,118	930,665
Detroit, Toledo & Ironton R. R.	2,791,754	3,257,259	2,828,035	3,290,497	774,436	789,016	2,053,599	2,501,481
Duluth, Missabe & Northern Ry.	8,694,801	3,765,586	8,876,825	4,110,499	1,939,175	1,509,592	6,937,650	2,600,907
Elgin, Joliet & Eastern Ry.	4,080,304	2,870,358	4,202,167	2,946,311	2,552,655	1,826,831	1,649,512	1,119,480
Erie System:								
Erie R. R.[6]	16,338,790	12,960,726	17,636,890	14,713,599	15,441,876	15,565,999	2,195,014	*852,400
New Jersey & New York R. R.	*346,184	*421,856	*342,228	*416,928	53,261	52,010	*395,489	*468,938
New York, Susquehanna & Western R. R.	333,216	356,977	397,106	420,639	797,838	799,981	*400,732	*379,342
Florida East Coast Ry.†	877,796	*222,593	984,954	*137,832	3,056,585	3,084,927	*2,071,631	*3,222,759
Fort Smith & Western Ry.†	53,429	*35,377	53,977	*34,750	293,494	293,653	*239,517	*328,403
Frisco Lines:								
Fort Worth & Rio Grande Ry.	*290,177	*265,161	*284,360	*257,736	1,041	113	*285,401	*257,849
St. Louis-San Francisco Ry.‡	5,880,915	2,045,513	6,315,147	2,622,086	12,980,647	13,107,820	*6,665,500	*10,485,734
St. Louis, San Francisco & Texas Ry.	*438,277	*503,422	*427,372	*492,557	136,965	136,933	*564,337	*629,490
Georgia & Florida R. R.†	*13,859	19,177	*4,066	29,194	654,474	648,658	*658,540	*619,464
Great Northern Ry.	23,559,571	23,491,275	28,608,740	27,307,584	18,704,754	20,160,303	9,903,986	7,147,281
Green Bay & Western R. R.	176,881	133,036	242,981	171,654	45,216	15,490	197,765	156,164
Gulf, Mobile & Northern R. R.	1,412,604	1,100,943	1,543,109	1,211,959	836,556	807,249	706,553	404,710
Illinois Central System:								
Central of Georgia Ry.†	1,239,804	1,039,510	1,637,730	1,441,364	3,664,753	3,689,562	*2,027,023	*2,248,198
Gulf & Ship Island R. R.	*146,384	*95,752	*125,139	*75,046	79,675	85,908	*204,814	*160,954
Illinois Central R. R.	14,087,852	[7] 6,108,950	17,055,467	[7] 7,919,900	16,340,722	16,523,662	714,745	[7]/*8,603,762
Yazoo & Mississippi Valley R. R.	2,911,164	[8] 560,293	2,992,674	[8] 611,927	2,942,676	1,940,565	49,998	[8]/*1,328,638
Illinois Terminal Co.	1,531,948	1,219,921	1,587,878	1,332,750	1,595,264	1,574,048	*7,386	*241,298
Kansas City Southern	3,133,292	1,486,403	3,498,353	1,927,145	2,917,978	2,882,876	580,375	*955,731
Kansas, Oklahoma & Gulf Ry.	809,019	551,037	877,224	619,024	244,258	232,117	632,966	386,907
Lake Superior & Ishpeming R. R.	1,195,756	834,857	1,198,689	868,661	526	362	1,198,163	868,299

* Deficit or other reverse items.
† Report of receiver or receivers.
‡ Report of trustee or trustees.
[5] Includes Atchison, Topeka & Santa Fe, Gulf, Colorado & Santa Fe, and Panhandle & Santa Fe.
[6] Includes Chicago & Erie R. R. and Erie R. R.
[7] Reduced by $4,821,354 charged to operating expenses in December, 1935, on account of equipment repairs made in 1934.
[8] Reduced by $455,823 charged to operating expenses in December, 1935, on account of equipment repairs made in 1934.

Selected Income Items by Regions and Districts, Class I Steam Railways, 1936 and 1935—Continued

Region and Railway	Net Railway Operating Income 1936	Net Railway Operating Income 1935	Total Income 1936	Total Income 1935	Total Deductions 1936	Total Deductions 1935	Net Income 1936	Net Income 1935
Lehigh & Hudson River Ry....	$187,533	$192,796	$224,110	$224,396	$618	$582	$223,492	$223,814
Lehigh & New England R. R...	807,313	822,797	834,156	849,996	436,296	416,287	397,860	433,709
Lehigh Valley R. R.....	8,700,958	4,982,747	9,664,947	6,011,543	8,341,122	7,855,344	1,323,825	*1,843,801
Louisiana & Arkansas Ry.....	1,090,601	1,132,072	1,184,537	1,226,007	850,175	797,023	334,362	428,984
Louisiana, Arkansas & Texas Ry.	*71,486	44,923	*69,679	46,820	45,320	46,153	*114,999	667
Maine Central R. R.....	1,467,937	1,809,732	1,954,636	2,320,362	2,037,251	2,186,021	*82,615	134,541
Midland Valley R. R.....	485,878	421,752	607,299	528,843	466,497	464,369	140,802	64,474
Minneapolis & St. Louis R. R.†	725,722	101,621	858,727	190,148	3,061,755	3,045,793	*2,203,028	*2,855,645
Mississippi Central R. R.....	108,502	25,616	110,148	26,971	134,300	131,656	*24,152	*104,685
Missouri & Arkansas Ry.....	34,261	22,770	48,772	24,507	791	74,563	47,981	*50,056
Missouri-Kansas-Texas Lines[9]..	4,323,240	1,920,843	4,833,989	2,514,319	4,972,198	4,963,397	*138,209	*2,449,078
Missouri Pacific System:								
Beaumont, Sour Lake & Western Ry.‡	*19,623	*33,410	*17,117	*30,432	177,938	175,126	*195,055	*205,558
International-Great Northern R. R.‡	148,032	529,900	191,019	571,468	2,850,017	2,856,594	*2,658,998	*2,285,126
Missouri-Illinois R. R.‡.....	103,365	51,122	105,714	53,597	137,575	138,855	*31,861	*85,258
Missouri Pacific R. R.‡.....	11,047,320	5,230,583	13,114,279	6,056,457	21,209,515	21,298,153	*8,095,236	*15,241,696
New Orleans, Texas & Mexico Ry.‡	347,007	443,568	456,016	518,090	2,698,928	2,665,482	*2,242,912	*2,147,392
St. Louis, Brownsville & Mexico Ry.‡	685,877	428,509	742,121	476,726	826,743	837,589	*84,622	*360,863
San Antonio, Uvalde & Gulf R. R.‡	*2,612	*319,135	7,750	*311,040	241,400	220,679	*233,650	*531,719
Texas & Pacific Ry.....	5,278,459	5,080,987	6,388,338	5,557,344	4,124,365	4,175,066	2,263,973	1,382,278
Monongahela Ry.	1,470,538	1,114,371	1,483,301	1,128,328	650,556	728,640	832,745	399,688
Montour R. R.....	953,449	844,898	968,957	898,418	82,739	86,959	886,218	811,459
Nevada Northern Ry.....	169,464	87,607	183,484	103,768	642	665	182,842	103,103
New Haven System:								
New York, New Haven & Hartfotrd R. R.‡.....	8,036,300	8,179,548	12,227,467	14,725,626	15,807,511	18,286,095	*3,580,044	*3,560,469
New York, Ontario & Western Ry.	1,040,638	1,360,560	1,250,994	1,600,072	1,581,837	1,596,486	*330,843	3,586
New York Central Lines:								
New York Central R. R.....	45,278,626	35,964,711	67,744,088	60,215,119	58,810,913	60,100,073	8,933,175	115,046
Pittsburgh & Lake Erie R. R.	4,895,227	3,762,399	5,429,754	4,168,839	838,505	923,466	4,591,249	3,245,373
New York, Chicago & St. Louis R. R.	9,137,723	6,759,546	14,956,239	8,650,491	7,575,757	7,534,562	7,380,482	1,115,929
New York Connecting R. R....	1,387,771	1,256,610	1,412,684	1,301,844	1,322,428	1,323,164	90,256	*21,320
Norfolk & Western Ry.....	34,505,424	27,303,818	37,014,156	29,988,981	3,907,497	4,442,531	33,106,659	25,546,450
Norfolk Southern R. R.†.....	302,538	325,428	483,944	480,991	875,589	902,801	*391,645	*421,810
Northern Pacific Ry.....	10,788,187	7,608,789	16,385,298	14,959,644	14,568,514	14,527,863	1,816,784	431,781
Oklahoma City-Ada-Atoka Ry...	107,890	60,979	110,430	65,167	45,410	2,863	65,020	62,304
Pennsylvania System:								
Long Island R. R.....	797,449	540,687	1,170,148	914,713	2,328,179	2,322,554	*1,158,031	*1,407,841
Pennsylvania R. R.....	84,180,592	70,394,641	120,300,126	106,808,064	81,558,034	82,958,266	38,742,092	23,849,798
Pennsylvania-Reading Seashore Lines	*1,232,479	*1,697,564	*1,060,664	*1,527,125	1,092,031	1,095,920	*2,152,695	*2,623,045
Pere Marquette Ry.....	5,578,349	4,828,197	6,165,835	5,194,916	3,407,831	3,561,618	2,758,004	1,633,298
Pittsburg & Shawmut R. R....	17,702	39,039	45,558	70,622	57,852	122,260	*12,294	*51,638
Pittsburgh & West Virginia Ry.	1,265,310	1,033,185	1,302,807	1,045,195	925,852	949,699	376,955	95,496
Pittsburg, Shawmut & Northern R. R.†	68,207	*12,920	75,719	*4,328	128,318	127,866	*52,599	*132,194
Reading System:								
Central R. R. of New Jersey	1,564,004	2,192,693	2,585,659	3,232,680	5,568,899	5,579,418	*2,983,240	*2,346,738
Reading Co.	13,944,785	12,562,360	16,111,868	15,102,486	9,596,797	9,388,313	6,515,071	5,714,173
Richmond, Fredericksburg & Potomac R. R.....	846,383	375,857	1,028,697	570,839	324,537	326,033	704,160	244,806
Rock Island System:								
Chicago, Rock Island & Gulf Ry.‡	343,244	84,360	477,808	219,498	1,426,128	1,431,062	*948,320	*1,211,564
Chicago, Rock Island & Pacific Ry.‡	657,437	*1,023,558	1,330,905	*372,182	14,711,885	14,651,389	*13,380,980	*15,023,571
Rutland R. R.....	99,504	*138,481	175,685	*63,388	417,060	419,594	*241,375	*482,982
Seaboard Air Line Ry.†.....	2,920,583	1,501,943	3,276,751	1,825,706	9,374,213	9,435,071	*6,097,462	*7,609,365
Southern System:								
Alabama Great Southern R. R.	905,801	429,547	1,974,638	801,282	485,516	497,846	1,489,122	303,436
Cincinnati, New Orleans & Texas Pacific Ry.....	4,936,368	3,583,309	5,080,533	3,706,016	1,749,193	1,729,394	3,331,340	1,976,622
Georgia Southern & Florida Ry.	137,524	104,514	145,572	113,037	305,906	316,353	*160,334	*203,316
Mobile & Ohio R. R.†.....	1,262,706	72,131	1,317,287	137,608	1,694,932	1,721,375	*377,645	*1,583,767
New Orleans & Northeastern R. R.	406,102	194,512	431,951	221,693	386,984	400,167	44,967	*178,474
Northern Alabama Ry.....	132,359	20,979	132,627	21,286	109,441	109,436	23,186	*88,150
Southern Ry.	19,298,273	14,290,530	21,523,577	15,655,538	17,218,651	17,404,739	4,304,926	*1,749,201
Southern Pacific System:								
Northwestern Pacific R. R...	249,796	6,119	267,666	30,953	1,507,076	1,505,784	*1,239,410	*1,474,831
St. Louis Southwestern Lines‡[10]	3,271,249	2,644,318	3,343,907	2,722,914	3,392,849	3,178,109	*48,942	*455,195
Southern Pacific Transportation System[11]	[12] 34,086,680	19,833,466	46,908,517	34,514,685	32,405,187	32,154,487	14,503,330	2,360,198
Spokane, Portland & Seattle Ry.	1,475,507	1,466,587	1,580,419	1,698,681	3,766,877	3,779,463	*2,186,458	*2,080,782
Tennessee Central Ry.....	471,851	410,331	480,163	418,228	303,378	302,936	176,785	115,292
Texas Mexican Ry.....	157,461	184,950	170,183	197,335	187,653	180,122	*17,470	17,213
Toledo, Peoria & Western R. R.	339,186	216,961	355,278	235,424	101,030	94,251	254,248	141,173
Union Pacific R. R.....	[13] 25,070,627	19,295,835	37,589,081	34,332,057	15,380,546	15,656,168	22,208,535	18,675,889
Utah Ry.	191,221	198,865	200,988	207,929	226,038	226,026	*25,050	*18,097
Virginian Ry.	9,068,958	7,240,264	9,604,271	8,231,631	3,222,243	4,118,007	6,382,028	4,113,624
Wabash System:								
Ann Arbor R. R.†.....	428,221	482,558	444,239	496,571	469,732	442,569	*25,493	54,002
Wabash Ry.†	6,147,522	5,213,899	6,515,412	5,595,158	7,796,194	7,863,626	*1,280,782	*2,268,468
Western Marvland Ry.....	4,784,216	4,107,677	4,924,247	4,252,172	3,214,134	3,249,515	1,710,113	1,002,657
Western Pacific R. R.‡.....	111,985	669,601	1,233,757	1,824,030	3,654,891	3,616,755	*2,421,134	*1,792,725
Wheeling & Lake Erie Ry.....	3,751,632	2,670,574	4,395,539	2,818,416	651,260	656,303	3,744,279	2,162,113
Wichita Falls & Southern R. R.	74,498	89,395	187,857	202,606	243,957	254,950	*56,100	*52,344

* Deficit or other reverse items.
† Report of receiver or receivers.
‡ Report of trustee or trustees.

[9] Includes Missouri-Kansas-Texas R. R. and Missouri-Kansas-Texas R. R. of Texas.

[10] Includes St. Louis Southwestern Ry. and St. Louis Southwestern Ry. of Texas.

[11] Includes Southern Pacific Company and Texas & New Orleans R. R. The figures shown exclude offsetting debits and credits for rent for leased roads, bond interest, and dividends between companies included. Also excludes dividends received from separately operated solely controlled companies during period January 1 to December 31, 1936, $444,127, and January 1 to December 31, 1935, $1,437,194.

[12] Net railway operating income of Southern Pacific Transportation System was increased approximately $1,900,000 during last six months of 1936 and "Other income" reduced about the same amount as the result of a contract effective July 1, 1936, requiring Pacific Fruit Express Co. to reimburse the railway company for certain services which under the previous contract were furnished without charge.

[13] Net railway operating income of Union Pacific R. R. Co. was increased approximately $819,000 during last six months of 1936 and "Other income" reduced about the same amount as the result of a contract effective July 1, 1936, requiring Pacific Fruit Express Co. to reimburse the railway company for certain services which under the previous contract were furnished without charge.

A. R. Wilson
President

J. C. Irwin
President-Elect

E. H. Fritch
Secretary

Engineering Officers Meet at Chicago

Increase in construction and maintenance activity reflected in large attendance at thirty-eighth annual convention of A.R.E.A.

CONFIDENCE in the outlook of the railroads and an appreciation of the expanded opportunities and responsibilities of the engineers in these days of rapid change in railway transportation were reflected in interest and enthusiasm shown by the members and guests who attended the thirty-eighth annual convention of the American Railway Engineering Association, which was held in Chicago this week. The expanded opportunities for the engineer were stressed also in the annual address of the president of the association, A. R. Wilson, engineer of bridges and buildings, Pennsylvania, Eastern region, Philadelphia, Pa. Two sessions each were held on Tuesday, Wednesday and Thursday in the Palmer House, together with a luncheon on Wednesday noon.

The procedure of the convention evidenced no marked departure from that which has been established throughout the life of the association and consisted in the main of the presentation of the reports of the various standing and special committees and the discussion of these reports from the floor. However, it was distinctly evident that the committees are becoming increasingly research-minded, as the chairmen of several of them voiced the need for some thorough-going investigations as the basis for reports on subjects assigned to them, and the reports of several committees cited research work in actual progress or in immediate prospect.

The outlook for further work of the association along this line was confirmed by the remarks of J. M. Symes, vice-president (operations and maintenance department) Association of American Railroads, Washington, D. C., who spoke before the convention at the opening session. Mr. Symes said that he looked forward to a continuance and an enlargement of research work by the railroads and added that when the research program of the Association of American Railroads has been thoroughly developed, he anticipated that the A.R.E.A. and its officers will have a large part in its activities.

Tangible evidence of the research work conducted under the auspices of the association and under the sponsorship of the Association of American Railroads was afforded by the report presented by Prof. H. F. Moore, University of Illinois, who is in charge of the investigation of fissures in railroad rails. It was indicated also by the report of the Special Committee on Stresses in Track, presented by Dr. A. N. Talbot, professor emeritus, University of Illinois, who has been in charge of this important investigation during the last two decades.

No formal report of the Committee on Clearances was presented, but President Wilson called attention to the fact that the Mechanical division, A.A.R., had asked the association to approve a minor increase in two dimensions of the Limits of Equipment Diagram, and at his suggestion a motion was made authorizing the Board of Direction to approve these changes upon further investigation. This motion carried.

Perhaps the one feature of the program that stimulated the widest interest from those in attendance was the address presented by Thomas H. MacDonald, chief of Bureau of Public Roads, U. S. Department of Agriculture, because of the large part which Mr. MacDonald has taken in formulating and directing the federal grade separation program. After citing the progress that has been made to date in eliminating grade crossings through the federal aid program, Mr. MacDonald referred to the planning surveys that are about to be undertaken to provide information for use in the formulation of a more extensive program for the future. Mr. MacDonald also suggested joint study of flood protection measures by

railway and highway authorities for the protection of adjacent thoroughfares as a further example of possible co-operative action. After explaining certain restrictions inherent to the expenditure of public funds, Mr. MacDonald paid a high tribute to railway officers for the co-operation that is being extended public authorities in the prosecution of the grade separation program. Mr. MacDonald's address will be printed in an early issue.

At the annual luncheon, which was attended by members and guests, Judge Harold B. Wells of the Court of Errors and Appeals of the State of New Jersey presented an address on "A Philosophy of Life."

Although the program of the convention embraced no evening meeting, the members were afforded an opportunity to participate in the "Engineering Night" dinner tendered to the members of the A.R.E.A. by the Western Railway Club. Following this dinner, which was held at the LaSalle Hotel, Dr. Talbot presented an address on the Relation of Track to Rolling Stock, an abstract of which will be published in a later issue.

According to the report of E. H. Fritch, secretary, the receipts during the past year exceeded the expenditures by $3,592.95 and the membership on March 1, 1937, totaled 1,926. The registration totaled 706 members and 278 guests, a total of 984, as compared with a registration of 662 members and 248 guests, a total of 910 last year.

New Officers

At the concluding session Thursday afternoon, the following officers were elected and were inducted into office. President, J. C. Irwin, valuation engineer, Boston & Albany, Boston, Mass.; second vice-president, E. M. Hastings, chief engineer, Richmond, Fredericksburg & Potomac, Richmond, Va.; treasurer, A. F. Blaess, chief engineer, Illinois Central, Chicago (re-elected); secretary, E. H. Fritch (re-elected); directors, F. L. Nicholson, chief engineer, Norfolk Southern, Norfolk, Va.; C. S. Kirkpatrick, chief engineer, Missouri Pacific Lines, Houston, Tex.; J. B. Hunley, bridge engineer, Cleveland, Cincinnati, Chicago & St. Louis, Cincinnati, Ohio; members of the nominating committee, H. C. Mann, operating vice-president, Union Pacific System, Omaha, Neb.; W. A. Murray, engineer maintenance of way, New York Central, New York; G. R. Smiley, chief engineer, Louisville & Nashville, Louisville, Ky.; H. H. Morrill, chief engineer, Maine Central-Boston & Maine, Boston, Mass., and C. H. Tillett, signal engineer, Canadian National, Toronto, Ont. In addition, F. E. Morrow, chief engineer, Chicago & Western Indiana and Belt Railway of Chicago, was automatically advanced from second vice-president to first vice-president.

E. H. Fritch Retires

A service of 38 years with the association was severed immediately after the installation of officers by an announcement from Secretary Fritch that he desired to relinquish his position. Mr. Fritch's career as secretary and assistant secretary has been unique in that it has embraced almost all of the association's history and all of the period during which it experienced its greatest growth and the fulfillment of its sphere of influence as an agency for the advancement of the theory and practice of railway engineering. Much of the success that the A.E.R.A. has enjoyed must be ascribed to the loyalty and zeal with which the work of the secretary was conducted throughout the long period that he occupied the office.

Mr. Fritch came to the association with a thorough training as a printer and his experience in this craft proved of inestimable value in the initial development of the association's publications and it was largely due to his inherent habit of accuracy and painstaking care that the bulletins, proceedings and the manual have always maintained a high standard of accuracy in spite of the involved character of much of the matter presented. The demonstrated value of his service resulted in his advancement—first to acting secretary and in 1936 to secretary, the position he occupied until his resignation this week. During his long service in this position, he acquired a knowledge of the association and its members and developed a sound judgment relating to association affairs that has been highly valued. A measure of the growth of the association during his service as secretary afforded by the fact that in 1906 there were only 528 members and 15 committees, compared with 27 committees and a membership ranging from 2,000 to 3,000 in recent years.

President Wilson's Address

The principal reason for the existence of this association is the assistance which, by the concerted action of its membership, it can give to the individual railway engineer and to the railways. In so far as it has fulfilled this purpose it has prospered. As long as it continues to be the most efficient agency for securing required engineering information and results it will continue to prosper, for it will be supported, not only by its own membership, but by the railways which reap the benefits of the work it does.

To follow its work through the annual proceedings gives one a most comprehensive idea of the improvement in the art of manufacturing transportation, and shows clearly what has been done to simplify practice and to standardize materials and structures, all of which promote maximum efficiency of the railroads.

In the early years of the association's existence it was decided to assemble in one volume the recommended definitions, specifications and principles of practice for railway engineering and maintenance of way work; special care being observed that only such matter be included as had been carefully considered by the association prior to its adoption at the annual conventions.

Two years ago the board of direction, recognizing that the 1929 Manual and supplements should be thoroughly reviewed and revised, authorized such work to be undertaken; a special committee was appointed and it employed a full-time editor under the general direction of the Manual committee. Today we see the results, a volume of inestimable value covering railroad engineering, that the association should regard as its proudest achievement.

The Engineer

There seems to be a growing consciousness on the part of the public and its leaders in public affairs that engineering is playing and will continue to play an increasingly important part in the activities of the modern world. All sorts of wild notions are brought forward as revelations of the short and direct route to new and greater opportunity. But as these have successfully failed to produce the wished-for result, or as safer thought has demonstrated their fallacy, the idea has become more widespread that, after all, technical knowledge and methods have played a major part in the stupendous advances of the last century.

Calmer minds, however, realize that, after all, it is not the scientist but the engineer who makes available to mankind the increasing technical, as well as scientific, knowledge which is such an important factor in modern life. Science, in short, is knowledge—knowledge of the work in which we live—but knowledge is, in itself, of secondary importance today. Rather, progress depends on our ability to apply and use knowledge as a tool with which man can increase his control over his environment

and this makes the world a better, safer place in which to live.

The suspicion that it is even more difficult to apply knowledge than to discover it is slowly gaining headway. Time was when the discovery of any useful truth was reflected almost immediately in improvements in life or living. Today this is no longer true—we know far more than we are able to apply. It is the man who has developed the technique of applying knowledge to the material needs of man who is in demand—the engineer.

Apparently the tide is turning. The engineer is to be called upon to aid in designing public policies and programs as well as public works. He has no mysterious and magic formula to suggest, but he has a viewpoint which is fundamental to the sane solution of any problem and a technique that reduces, so far as is humanly possible, the risk of making costly errors or mistakes. These should be valuable assets to a nation, state, or community as well as to private enterprise. They require a careful, honest, unbiased attempt to see, appraise, and evaluate all angles of a problem and similarly honest and painstaking planning to meet these needs.

Throughout the ages, the engineer's principal stock-in-trade has been his reputation for absolute honesty and care in searching out, analyzing and appraising the basic facts and economic values of these enterprises in the field of his professional activities. When he has recommended a work, he has staked his reputation and standing on its feasibility and soundness.

In a large measure, progress in engineering is marked by the reduction of engineering technique to a science. Beginning about the time of our Civil War, engineers began to compute stresses from loads, to test materials, and to proportion structural parts to meet the stresses which analysis showed they would be subjected to. This development was supported, as it led to economy.

Standardization may discourage research, but research is bound to aid standardization—our progress may be retarded by reducing our ideas and mind to a standard. Research and more research "promotes knowledge of the properties of the materials and methods of engineer." This knowledge must be obtained before sound specifications can be promulgated and before sound practices can be recommended.

Research in the civil engineer's field has showed remarkable activity and achievement during the past year. Such work has been carried on by various agencies and universities, and includes fatigue tests on heat-treated wire as used in cable wire for bridges, further development of the chemistry of metals, methods of manufacture, heat treatment, resistance to fatigue and corrosion. It would seem that we are now or soon will be faced with the necessity of using less material for our design, thus placing a premium on technical skill and ingenuity, and requiring more reliable data on the properties of materials.

Recently great improvements have been made in filler metal for welds. Not only has the ductility been increased by using heavily-coated electrode, but filler metals now available produce welds that equal or exceed the base metal in other physical properties. The international conference at Havana last June revealed the wide extent of practical interest in the new science of soil mechanics—this new science making a powerful impression on engineering practices during the past year.

Under the direction of the Rail committee, the tests at the University of Illinois contributed information on the prevention of fissures in rails, shown to be due to "shatter cracks" in the head of the rail. The Association of American Railroads has, with the rail manufacturers, appropriated an additional sum to extend this work until January 1, 1939.

To be of maximum value, all research activities in railroading must be co-ordinated with one major objective in view; an objective which keeps constantly in mind the place of the railroad in the transportation fabric of the country. All past studies, technical, social and economic, must be carefully analyzed, and new developments planned to suit the constantly changing conditions, but with the main objective in mind.

Report on Electricity

H. F. Brown, Chairman*

As in past years, in fulfilling its assignment to keep the association informed of developments in the application of electricity to railway service, and of the current activities of the Electrical section, A.A.R., the committee presented a brief synopsis of the reports made by the different committees of the section in 1936, which were published in full in Bulletin 388, dated August, 1936. The subjects covered in the reports were as follows:

Power supply; electrolysis; overhead transmission line and catenary construction; standardization of apparatus and materials; electric heating and welding; application of motors; clearances for third-rail and overhead working conductors; protective devices and safety rules in electrified territory; specifications for track and third-rail bonds; illumination; design of indoor and outdoor substations; high tension cables; and application of corrosion-resisting material to railroad electrical construction.

In presenting the report of the convention, Chairman Brown discussed the various subjects in some detail, particularly those of special interest to engineering and maintenance of way officers. W. A. Radspinner (C. & O.) questioned whether the factor of safety as regards fire hazard had been given full consideration in the handling of certain of the subjects, and was assured by the chairman in each case that it had been.

* Assistant Elec. Engineer, New York, New Haven & Hartford.

Report of Committee on Ties

John Foley, Chairman*

The committee gave consideration to all of its ten assignments during the year, but reported on only six. No changes in the Manual were recommended, but highly concise and informative completion reports were made on the best practices in handling ties from their manufacture to their installation in the track, and on the effect of different kinds of ballast on the life of ties.

Adherence to Specifications

The committee based its report upon the observation of approximately 1,100,000 crossties at four different wood-preserving plants, all commercially owned, representing producing territories in the Central Mississippi and the Lower Ohio River valleys. The ties examined were mainly oak, although gum, pine, beech, birch and maple were also included. The committee said, in part, that "the general condition of the storage yards as regards drainage, freedom from weeds, debris, etc., was to be commended, but in certain of them the ties were not carefully spaced for seasoning. In one yard, anti-splitting irons were not being put in until splits had started. Workmanship in the manufacture of the ties was satisfactory in general, although some of the smaller ties, especially hewn ties produced locally, were rough and not well trimmed. The ties of the larger sizes were usually well up to standard dimensions. When not fully dimensioned, the oversizing was generally in thickness. In one yard, the width of ties apparently was determined by body width instead of top width. In all of the yards observed, the smaller ties were not so well sized, many being accepted one size high. Inspection in regard to the size of knots accepted appeared rather lax."

As a result of its observations, the committee again repeated its opinion that the greatest ultimate economy in the use of ties is obtained by adhering to the standard specifications at all times, and that so doing best serves the interests of both producer and consumer.

Substitute Ties

Because of the lack of any special developments during the year, the committee omitted again this year its usual report on substitutes for wood ties. It did, however, present a final report upon the test of Bates reinforced concrete ties installed in the track of the Elgin, Joliet & Eastern, at Whiting, Ind., which was furnished by Arthur Montzheimer, chief engineer. The test on the E. J. & E. included 62 Bates ties, which were installed in May, 1912. In general, the ties were made with truss rods, cross stays, wear plates and hook bolt anchor plates, but a number of them incorporated several modifications in design.

The first of the failed ties, two in number, were removed from the track on July 5, 1930, because the concrete at rail joints had been battered and broken down. A few other ties were re-

* Forester, Pennsylvania Railroad.

moved in 1931 and in 1933, while the bulk of them were taken from the track on May 12, 1936, because the connecting or reinforcing rods which held the two concrete blocks together were so rusted that there was danger of the track spreading. The rail fastenings were also quite severely rusted.

Summing up the condition of the ties as removed, and the service obtained from them, Mr. Montzheimer reported, in part, as follows: "We were unable to see any difference in the wear and service of the differently constructed ties, as all of the ties were in practically the same condition when removed from the track. The concrete was worn or cut so that the rail was riding on the reinforcing rods. In general, the Bates ties gave very good service. We had no trouble in keeping the track in good line and surface. The traffic over the track including the ties was very heavy, but the average speed was confined to between 15 and 20 mi. per hr."

Best Practice, Manufacture to Installation of Ties

Under this assignment, the committee brought together in ready reference form rules and other information which are recognized as representing approved procedure in the handling of ties from the time they are manufactured to their installation in the track. This material, which incorporates data assembled in the past by several committees, and adopted as recommended practice by the association, was presented in the report in the sequence in which the particular problems present themselves, beginning with the cutting of the ties in the woods and ending with a discussion of the care of ties after treatment.

The various specific heads under which the information was presented, are as follows: Cutting season, adherence to specifications, manufacture, piling in the woods, ties delivered at river landings or railroad stations, transportation, inspection, seasoning before treatment, anti-splitting devices, machining, treatment, selection of ties for various classes of lines, storing ties after treatment, tie renewals, and care of ties after treatment.

In presenting its recommendations, the committee pointed out that while the rules suggested apply generally, it is not possible to present specific rules applicable to all conditions of traffic, climate and timber supply.

Effect of Ballast on Tie Life

In studying this subject, the committee gave specific consideration to the effect of different kinds of ballast on the life of ties. Referring to a report of the Committee on Ballast, presented in 1933 when this subject was being handled by that committee, the committee stated that the earlier report appears to be a fair presentation of present opinions, and that it concurs in the conclusion arrived at, that a somewhat greater age will be attained by the average tie in stone ballast than in gravel ballast under identical roadbed, rail and traffic conditions. At the same time, it said that, in fairness to the many miles of good track, with good ties on good-grade, well-drained ballast of materials other than stone, it could not agree with the earlier report that the degree of damage to the ties caused by ballasts other than stone is as great as might be assumed from the comparison presented.

Following is a resumé of the conclusions reached by the committee on this subject:

Apparently, no injurious chemicals are present in smelter slag, blast furnace slag, limestone, trap rock or gravel. Chats contain a chemical which is apparently not injurious to ties, while, at the same time, it is a deterrent to weed growth. This chemical is, therefore, beneficial rather than harmful to the ties and track conditions. Cinders contain chemicals which are not destructive to the ties. These chemicals are, however, destructive to the cinders themselves, which become foul, provide improper drainage, and thereby tend to cause salt preservatives to leach.

Sharp-edged ballast, such as smelter slag, does wear the surface of ties, but this abrasion is not serious. All of the mechanical wear which occurs on the bottoms or sides of ties due to the character of the ballast or the work of surfacing track by commonly accepted and approved methods, is negligible.

Ballast which retains moisture induces decay in untreated ties and causes the eventual decay of ties treated with salt preservatives through the leaching of these preservatives. In wet ballast, centerbound track is more prevalent, and heaving is aggravated, necessitating excessive tamping, shimming and spiking, which result in undue mechanical damage to the ties. Ballast which cements readily also causes centerbound track and water pockets, and sets up unusual strain in the ties.

Tie Renewal Statistics

As in past years, to meet the requests from many quarters for early publication of the tie renewal statistics brought together yearly by the committee, the committee issued its report on this subject in June, 1936. This report was included in Bulletin No. 386, and was abstracted in the *Railway Age* of August 29, 1936. The report was presented in the same form as in previous years, and included data regarding ties renewals for the year ending December 31, 1935, and for the five-year period ending the same date, for both the larger roads of Canada and the Class I roads of the United States. The statistics for the roads in the United States were based on reports of the various roads to the Interstate Commerce Commission.

Other Subjects

The committee presented an outline of its complete field of work, and, without report, indicated progress in the study of the following subjects: Proper seasoning of oak ties, with special reference to those grown in Southern lowlands; effect of volume of traffic on the life of creosoted ties; reuse of treated ties in track or elsewhere after their removal from their original positions; and revision of the Manual.

The report was received without discussion.

Report of Committee on Stresses in Track

Dr. A. N. Talbot, Chairman*

The special committee on Stresses in Railway Track, co-operating with the American Society of Civil Engineers and with the Association of American Railroads, continued during the year its study of a number of matters relating to railway track construction, including an investigation of the action of continuous welded rail in track, the determination of lateral and vertical impact effects of motive power operated at high speeds, rail joint action under high-speed operation, and the measurement of rail depressions under moving loads. The report of the committee, however, contained only brief reference to the progress made along each of its lines of study.

The committee stated that it had continued its observations of the installations of continuous welded rail on the Delaware & Hudson, and had begun tests on the one mile of such rail installed on the Bessemer & Lake Erie. It pointed out that the purpose of these observational tests is to determine the magnitude and distribution of the anchorage given by the ties and ballast at the ends of the welded stretch and along its length to resist the forces set up by changes in the temperature of the rail, and to learn how the influences tending to change the length and alignment of the rail are met by the track, both in the early life of the track and at later dates when time and traffic may have had opportunity to show their effects.

As regards the vertical impact effect of motive power operated at high speeds, the committee reported that it had continued the study of test data taken by the Pennsylvania, and is of the opinion that these data will eventually furnish useful information. Citing only one of the possible determinations resulting through these tests, the committee stated that on straight track lateral impacts appear usually to be accompanied by high vertical loads on one rail.

Commenting upon its tests of rail joints, the committee disclosed that further testing of rail joints under high-speed operation, in co-operation with the Pennsylvania, had been postponed somewhat because of delay in obtaining some of the equipment necessary to the conduct of the tests, but said that a considerable program is now planned which should give information on several representative types of joints under a number of service conditions, including high speed operation. Further, as regards rail joints, the committee reported that a rolling load machine for the determination of the wear of rail joints has been designed, and that it is expected that one of these machines will be built in the near future. This machine will have

* Professor Emeritus, University of Illinois.

a sufficiently long stroke and will support the rail in such a manner as closely to approximate the variation between positive and negative bending moments which takes place in a rail joint in the track.

As regards other subjects under consideration, it was stated that the committee plans to co-operate with the Committee on Rail in its service tests on rail joints in track, and is giving consideration to photographic and electrical methods of measuring rail depressions under moving loads.

In presenting this report Dr. Talbot displayed some charts summarizing the data obtained in the investigation of the stretches of butt-welded rail on the Bessemer & Lake Erie and the Delaware & Hudson. Among other facts presented, these showed that no appreciable change in the length of the stretches of rails with changes of temperatures took place within seven rail lengths of the ends of the continuous sections. It was also found that the stresses in the rails within the distance in which the length did not change varied from a compressive stress of approximately 10,000 lb. per sq. in. in summer to a tensile stretch of 10,000 lb. per sq. in. in the winter, and that the stress gradient at the ends was fairly uniform. Charts were presented also showing the dip in the ends of rails resulting from the tightening of bolts in badly worn bars, while charts of the stresses in worn bars, when bent laterally by tightening the bolts, recorded stresses so high as to leave little doubt as to the reason for failures that result from this practice.

Report on Uniform General Contract Forms

L. F. Nicholson, Chairman*

Only one new form of agreement was submitted by the committee in a relatively brief report, this being an agreement for cab stand and baggage transfer privileges, which form was offered for approval and for inclusion in the Manual. The committee presented no revisions of forms already in the Manual, having reported thoroughly on this assignment in 1936, but reported progress in the preparation of a form of agreement with public authorities for highway grade crossing elimination or separation.

Form of Agreement for Store-Door Delivery

The committee called attention to the form of agreement for pick-up and store-door delivery, which it presented to the association as information in 1936, and indicated that further study did not warrant any change in this form at the present time. It pointed out that, as presented, the form is available to and should be of assistance to those interested in this subject.

Form of Agreement for Cab Stand Privileges

Continuing its work of last year, when it presented as information a tentative form of agreement covering cab stand privileges, the committee offered a final form of agreement for cab stand and baggage transfer privileges, which it recommended for adoption and inclusion in the Manual. This form, relatively short, embodies best practice as determined from the study of many existing forms in use, and is in line with the general recommendations of the committee for bringing about greater uniformity among the various forms of agreement adopted by the association. The various terms or subjects covered in the form are: Grant, parking space, transfer cabs, transfer—station to station, agents and employees, transfer rates, hotel solicitation, baggage records, claims, waybills, loss and damage, liability, consideration, terms, and assignment.

With minor changes in wording, in no way affecting the sense or scope of the form of agreement, the form was approved for publication in the Manual.

Outline of Work

The committee stated that during past years it had drafted and presented to the association forms of agreement for nearly all of the subjects with which the engineering department of a railroad must deal, and, as a result, now finds it difficult to set up a program fixing subjects that have been covered by contract and those that have not yet been developed, but for which contracts are required. Commenting upon its future work, the committee said that this appears to be fourfold; first, to encourage the adoption by the railways of uniform forms of standard documents, so far as consistent with the various state and national laws; second, to continue the study of agreements in the Manual, suggesting changes or revisions in the forms, and editing them so that users of the agreements can adjust them readily to suit particular conditions; third, to confer and to collaborate with other committees of the association and other national organizations, to the end that there will be no overlapping of effort; and fourth, to be on the alert at all times to discover and formulate new and additional forms required by changing conditions in railroad operation and maintenance.

* Chief Engineer, Norfolk Southern.

Maintenance of Way Work Equipment

C. R. Knowles, Chairman*

The committee presented complete reports on electric tie tampers, machines for laying rail, power bolt tighteners, and on an outline of its work; progress reports on the use and adaptability of crawler-type tractors in maintenance of way work and on track welding equipment; and reported progress in the study of six other assignments.

Electric Tie Tampers

The report of the committee included a discussion in some detail of the design and operation of five types of electric tie tampers available, including the vibrating type, the direct blow type, the magnetic type, the electric-pneumatic type, and the electric or mechanical-pneumatic type. No attempt was made to compare the merits of the various tools described or to recommend any type for any class of tamping. However, as a result of its study, the committee presented the following conclusions, which have to do with methods of tamping and suggestions to the manufacturers of this class of equipment in order to adapt the equipment more fully to the work for which it is designed and make it more economical of repair and maintenance:

"(1) The committee is of the unanimous opinion that the motors furnished for electric tools should have removable stators to permit a completely rewound stator to be inserted, and that exchange service should be established.

"(2) While not unanimous, it is, however, the opinion of the majority of the committee that the manufacturers of electric tamping power units should give thoughtful consideration to providing internal combustion engines whose makers have an exchange service for a factory-reconditioned engine at a reasonable cost.

"(3) It is the opinion of the committee that all power plants should have a suitable circuit breaker that will quickly open at least two lines of a 3-phase 3-wire circuit, two lines of a 2-phase 4-wire circuit, and one line of a single-phase 2-wire circuit, unless the generator is of a special design that will limit the current output to a safe value under any accidental or sustained short circuit that may occur.

"(4) There is a wide difference of opinion among maintenance officers on methods of tamping. It is evident, therefore, that the subject is of such importance and the opportunities for improvements and cost reductions so great that the officer who will give thoughtful consideration to the many methods of tamping will be amply repaid for his efforts."

Crawler-Type Tractors in Maintenance of Way Work

Continuing the information presented in its previous reports, which included discussions of the general design and operation of crawler-type tractors and some of their attachments especially designed to perform various classes of maintenance of way work, the committee this year studied and reported upon the relative advantages and disadvantages of gasoline engine-operated and Diesel engine-operated crawler tractor units.

As regards the general adaptability of these units to maintenance of way work, it said, in part, as follows:

"A recent survey disclosed a general acceptance of the crawler-

* Superintendent Water Service, Illinois Central.

type tractor by the railways, and a wide range of applications. The use of welding equipment, air compressors, front-end loaders, post hole diggers and various types of earth-moving equipment mounted on crawler treads has advanced rapidly. These machines appear to have passed the experimental stage and have become established units of work equipment. Bulldozers, snow plows, brooms and front-end loaders are accepted universally as economical and effective snow-fighting equipment."

Following a brief discussion of the fundamental differences between gasoline and Diesel engines, the committee pointed out that the outstanding advantages of the Diesel engine over the gasoline engine appear to be that it has a flatter torque curve which increases its lugging ability; that it is more economical to operate because of a smaller fuel consumption and a lower grade of fuel oil; and that it presents less fire hazard. However, in spite of these apparent advantages, it cautioned that there are several other factors or questions which should be taken into consideration before deciding upon the purchase of Diesel tractors over gasoline tractors. These it listed as follows: Is proper Diesel fuel available? Can a Diesel engine be serviced and maintained properly with the present organization? Will the fuel economy justify the additional expenditures involved in increased first cost, interest, depreciation and maintenance?

As regards the increased use of Diesel engines in recent years, and the economy of this type of engine for powering maintenance of way equipment, the committee had the following to say:

"The great increase in the use of Diesel engines in other industries would indicate a decided superiority of this type of engine over the gasoline motor, but it should be noted that the Diesel engine has had its greatest success in fields where its work is nearly continuous, while in railway maintenance work the tractors are idle more or less of the time. Since the economy of the Diesel is dependent largely on its fuel consumption, and the fuel consumption depends upon the number of hours worked, while the fixed charges do not vary, it follows that a Diesel might prove economical when it is kept working, whereas it will not prove economical unless it is worked a certain amount of hours per year."

In answer to a question, Chairman Knowles said that Diesel engines required more maintenance than gasoline engines but that no greater skill was demanded of the maintainer.

Machines for Rail Laying

After pointing out in its report that no group of roadway machines and small tools developed in recent years, especially designed for maintenance of way work, have made their appearance at a more opportune time or have filled a greater need than the pneumatic and gasoline-powered rail laying units, the committee described those machines and tools which are in general use for this class of work. The various tools were discussed in several groupings. Under pneumatic tools were described track wrenches, rail drills, rail bonding drills, wood boring machines, screw spike drivers, a GEO drill, cut spike drivers, a spike puller, a rivet buster, and a spike setting and driving machine. Under roadway machines were included adzing machines, the power unit spike puller, power rail drills, the power unit track wrench, a power track machine wrench, and the power tie borer. Other units described included gasoline engine-driven air compressors, cranes, a pneumatic hose trailer, and a tie plug driver.

Power Bolt Tighteners

In a relatively brief report, the committee reviewed the history of the development of power bolt tighteners and the growing demand for light, portable machines, and then described several of the more widely used units, including the Woolery bolt tightener, the power track wrench of the Nordberg Manufacturing Company, and the Raco power track machine of the Railroad Accessories Corporation.

In concluding its report, the committee said as follows:

"In addition to economy, some benefits claimed to have been shown by power tightening are:

"(1) That proper and uniform tightening gives track bolts the equalized tension necessary to assure uniform expansion and contraction, to reduce rail batter, to contribute to better riding track, and to reduce materially the wear of angle bars.

"(2) The utilization of machines for out-of-face joint maintenance ranges in practice from assigning machines alternately to sections, to the use of two or more units in tandem, one or more on each rail, and the provisions of camp car facilities for crews assigned permanently to the work. Some roads have formulated definite schedules for joint maintenance covering the entire system.

"(3) The percentage of time usefully expended by section forces while engaged in tightening bolts by hand has often been problematical. The combination of the release of section forces from all except periodic joint inspection, with a more positive and systematic method, is one of the newer angles of mechanized maintenance seeming to offer most attractive possibilities.

"(4) Wrenches which combine lightness, speed, power, simplicity and sturdy construction are most desirable. Sufficient power should be available to break bolts where nuts are frozen to the extent that they cannot be removed."

Track Welding Equipment

Supplementing its reports on this subject, presented in 1933 and 1934, which included brief discussions of the various types of welding equipment then available, the committee in this year's report described in some detail a new design of welding machine, which it pointed out, incorporates a number of novel features. Commenting upon a series of volt-ampere curves of the machines, the committee pointed out that they indicate the following desirable characteristics:

(1) Short circuit current is only slightly greater than the welding current, which tends to prevent sticking when the arc is struck.

(2) The open circuit voltage is comparatively low, which minimizes the danger of shock. The open circuit voltage is the same for all settings.

(3) When operating on small currents, the voltage is relatively high, which makes it easy to strike and hold arcs at low current settings.

In addition to the above, the committee discussed other advantageous features of the machine and presented a table showing the weight of this type of portable motor-driven machine, in comparison with an older type of portable motor-driven machine having a separate exciter and transformer reactor, manufactured by the same company.

Other Subjects

In addition to the subjects reported upon as indicated above, the committee presented an outline of the complete field of its work, and reported progress in the study of the following subjects; Revision of the Manual; standardization of parts and accessories for railway maintenance motor cars; depreciation of work equipment; methods of keeping data on work equipment and labor-saving devices; the scheduling and use of work equipment; and power saws.

Waterproofing of Railway Structures

J. A. Lahmer, Chairman*

In a brief progress report, which consisted essentially of an outline of its field of work, the committee pointed out that in addition to giving consideration to the material appearing in the Manual, it has under study two principal subjects as follows: Specifications for materials and the application of bituminous emulsions, and the conditions under which it is preferable to use for waterproofing or damp-proofing, asphalt or coal tar in the form of emulsion, hot liquid without membrane, or cut-back.

As regards materials and the application of bituminous emulsions in waterproofing and dampproofing railway structures, specifications concerning which were presented last year as information, the committee stated that further careful consideration had been given to these specifications during the year, and that at one of its meetings it had had the benefit of the knowledge of representatives of the technical staffs of the leading pro-

* Senior Assistant Engineer, Missouri Pacific.

ducers of bituminous materials in the country. During the coming year the committee proposes to give further consideration to the specifications, with the hope of presenting them at the next convention for adoption.

The report was received without comment from the floor.

Waterways and Harbors

F. E. Morrow, Chairman*

The committee presented detailed reports on three of its assignments, and stated that progress had been made in the study of the other seven. Completing its study of two subjects for the present time, it recommended that they be discontinued. It reported further that it was the concensus of the committee that the subject breakwaters, bulkheads and jetties be held in abeyance for the present.

Warehouse Piers, Coal Piers and Car Float Piers

The committee gave primary attention to warehouse piers, their place in a water terminal, and the essential features of their construction. No attempt was made to deal with details of construction which are governed largely by local conditions. Following general comments concerning the more prevalent features of design and construction found in existing warehouses on piers, in which reference was made to types of construction, lengths and widths of piers, number of stories, fireproof construction, doors and arrangement of tracks, the committee stated, in part, as follows:

"The design of pier sheds or pier warehouses should be considered on the basis of requirements. It is of doubtful advantage to have structures of too permanent a character in view of general changing conditions.

"The practice has been to place rail facilities through the center of warehouse piers, usually one or two tracks, at the wharf surface or depressed. Where freight is handled directly from ship slings to cars, trackage on the outside edges of the warehouse piers has been favored. This arrangement has also been recommended in connection with warehouse piers where the freight moving to and from the piers is handled in part by motor trucks. It has been found that tracks in the center of the shed interfere with the loading process.

"A great many piers can be used as warehouse piers to some extent. A shed can be constructed thereon, or it can be used to store materials in the open. The design of the pier will, no doubt, restrict its use both as regards load and methods of operation. In order to design the pier properly, it is necessary to know the type of warehouse that is to occupy it, the general features of construction, the space required, storage capacity, floor loads, trackage, mechanical handling devices, elevators, driveways, and the important features of operation."

With particular reference to the factors pointed out immediately above, the committee compiled a large amount of information with regard to warehouse piers and warehouses located at rail-water terminals, which it presented as part of its report. This information included data assembled by the Committee on Yards and Terminals in 1931, but never presented in printed form. Commenting upon this material, the committee stated that of the warehouses reported on, only approximately 25 per cent are less than 25 ft. from the dock side, which seems to indicate that most of the warehouses are not located on piers and, therefore, do not come within the scope of its assignment. However, in presenting the data, the committee felt that it would be of value to the designer of warehouse piers for his consideration, and for further investigation, if desired.

The latter part of the committee's report included descriptions of a pier on the Norfolk & Western on the east shore of the Elizabeth river, just inside of Hampton Roads; a pier on the Northern Pacific on the downtown waterfront in Seattle, Washington; and a pier on the Erie, on the west shore of the Hudson river, at Weehawken, N. J.

Slips Required for Various Traffic Conditions

After defining the scope of its study as limited to the type of waterways between piers and other structures, providing access to general cargo and ferry facilities, the committee first discussed slips in general, giving particular attention to their dimensions. In this regard, it pointed out that in determining the size and depth of a slip to serve any particular facility, the proposed uses and requirements of that facility must be carefully considered. These uses and requirements, it stated, vary to such a large degree that it is practically impossible to set up definite dimensions for slips, even by classifications such as passenger, passenger and cargo, cargo, coal, ore, grain, etc. It pointed out that an important consideration in the determination of the dimensions of a slip, particularly its width, is the value of the land behind the established bulkhead line, which is generally the line along the base of the pier.

Following these more general comments, the committee discussed under separate heads, passenger and car ferry slips, the depth of slips, and construction and maintenance costs, and then presented statistical data with regard to the dimensions and depths of a large number of various types of slips about the country. At the end of its report, the committee presented as information the following conclusions and recommendations:

"(1) The size and depth of slips depend upon so many variables that it is the opinion of the committee that each layout must be treated on the basis of local information, but, as an average, it is recommended that for two-berth slips (approximately 1,000 ft. long) for servicing general merchandise cargo vessels, a width of 300 ft. is satisfactory, with a depth to correspond to the depth governing in the approach channels or to account for tidal range.

"(2) Cost of construction and maintenance are so variable that such can be developed only by questionnaires, and even then it is felt that the information obtained would be so specific as to make it of no general value. The circulation of questionnaires is not recommended.

"(3) The committee is of the opinion that the determination of slip dimensions is so dependent upon the design of the facility the slip serves, that study of the design of such facilities, with recommended slip dimensions included, would not be of benefit to the association, and, therefore, recommends that this report be published as information and the subject discontinued."

What is Navigable Water in Fact

This report was essentially a review of court decisions and interpretations covering navigable waters and state and federal jurisdictions over them. After presenting the court decisions which give the federal government control over navigable waters under the commerce clause of the federal constitution, the committee pointed out that whether a water body is navigable within the decision referred to, depends upon the facts in each particular case. It also pointed out the scope of state jurisdiction, and presented decisions from which it is seen that there are three important factors which the courts have looked to in making their findings on the navigability of water bodies, viz: present use; potential use; and physical condition when in natural state.

Supplemented by numerous references to court decisions, the report stated that the courts have passed upon the present use of water bodies in a great variety of situations. Some of these bodies were considered navigable where navigation was possible for only a few months of the year; where portages were necessary; where a stream had artificial obstructions in it, such as dams; where sand bars and rapids interfered; where the principal use was limited to floating logs; and where there has been little use because of the sparsely settled locality.

On the other hand, a decision was presented to show that water bodies have been held to be non-navigable where the evidence of navigation was scanty. This same finding, it was pointed out, was made where navigation was confined to short periods of high water during the year, and when conducted under difficulty.

In concluding its report, the committee said, in part, as follows:

"In cases where federal bureaus attempt to treat water bodies as navigable within the commerce clause and there is some question about the navigability, it is important that a careful study of the entire situation be made by the parties in opposition to such action. The history of the stream should be gone into to find whether in the past the body had been put to any such use. If it had, then the extent of the use is important, because courts will disregard insignificant uses, as shown above. If other forms of transportation have displaced navigation, the present navigability may be put in doubt, especially where the early navigation

* Chief Engineer, Chicago & Western Indiana.

was impractical. The navigation, or possibility of such, should be such as would be of some material consequence in the trade and commerce of the locality. The mere fact that there is a stream which might be navigable does not automatically give the federal government control of it. A sensible construction must be given to the commerce clause as the cases referred to illustrate. Such construction would definitely limit the federal government's powers to only those streams which are navigable in the commercial sense of the word. As we have seen from the cases referred to, the federal government cannot extend its control to the tributaries of navigable waters, and there is authority to the effect that there must be evidence of actual or possible interstate or foreign commerce before the federal government can take control of the water body.

Except for the few general principles which have been crystallized by constant reiteration down through the cases, navigability depends almost completely on the facts in each particular case. A common sense analysis of the use or possibilities of the use of a stream in its natural state has to be made in every instance. The courts make the final determination of navigability but the attitude the courts will take may be fairly well determined if the facts of the navigability are thoroughly investigated."

The committee recommended that the subject be discontinued.

Other Subjects

Other subjects given consideration by the committee during the year, but not reported upon, include the following: Revision of the Manual; levees, dikes and mattresses; economical principles involved in clearances over navigable waterways; seawalls and ocean shore protection, including the effect of wave action and ice; reasonable life of steel casings immersed in sea water; waterway projects of the United States; and outline of complete field of work.

The report was received without discussion.

Report on Standardization

E. M. Hastings, Chairman*

In fulfilling its assignment, the committee presented a revised list of the A.R.E.A. specifications and recommended practices which it felt were worthy of consideration for adoption by the railways generally. It also reported again upon its efforts to seek national standardization of certain A.R.E.A. recommended practices, and upon the activities of various standardization bodies in this country and in Canada.

A.R.E.A. Practices Advocated for General Use

The committee reviewed the matter presented in its report of last year, which included a tabulation of the standard specifications and recommended practices of the association which it recommended as worthy of consideration for adoption as uniform practice on all railways in the interest of efficiency and economy, and, as a result, presented a revised list this year, with the same recommendation. The revised list, prepared after careful study of all of the material presented to and adopted by the association, included 106 items. These were set up in numbered subdivisions conforming to the standing committee numbers, with necessary references to the new edition of the Manual.

National Standardization of A.R.E.A. Practices

The committee reported progress in its consideration of what A.R.E.A. recommended practices should be recommended for national standardization, and stated that it had recommended to the Board of Direction, for national standardization, the association's specifications for the manufacture and installation of motor truck, built-in, self-contained and portable scales for railway service, adopted in 1936. The Board, in turn, it reported, voted to present this project to the American Standards Association.

The committee also called attention to the fact that A.A.R. Bulletin No. 2, Recommended Standards, Railroad-Highway Grade Crossing Protection, issued by its Joint Committee on Grade Crossing Protection, July, 1935, is now being considered by the A.S.A. for national standardization, with the prospect of its early adoption.

In addition to the above features of its report, the committee commented in some detail upon the current activities of the American Standards Association and of the Canadian Engineering Standards Association, and presented a list of the standards approved by the A.S.A. from September 1, 1935 to September 1, 1936, and a list of the A.S.A. projects on which the Association of American Railroads is now co-operating.

The report was received without discussion.

* Chief Engineer, Richmond, Fredericksburg & Potomac.

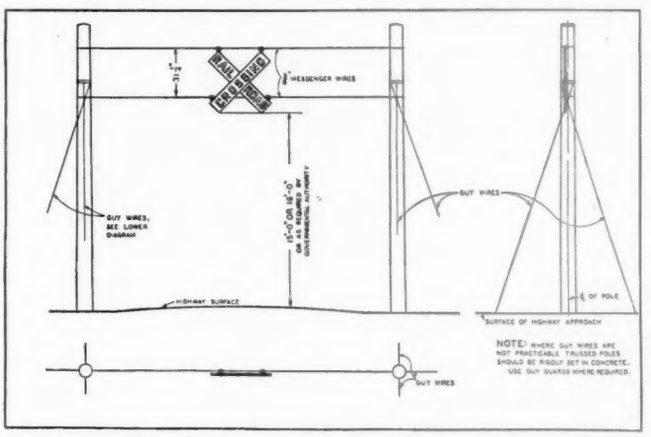
Report on Highways

J. G. Brennan, Chairman*

The feature of the work of the committee during the last year was the preparation for adoption and inclusion in the Manual of a group of drawings covering crossing signs for suspension over a highway. In addition it presented for consideration another group of drawings of "Gates-Not-Working" and "Watchman-Not-on-Duty" signs, and reported in some detail on two other subjects.

Revision of the Manual

The committee pointed out that at highway-railroad grade crossings, where, because of local conditions it is not practical



Drawing Showing Method of Mounting 90-Deg. Railroad Crossing Sign When Suspended Over a Highway

to place the crossing sign on a post, the sign may be suspended, and that the sign itself may be used with or without reflecting units as conditions require. With this in mind, it prepared and presented as its report a group of six drawings covering the situation, which it recommended for publication in the Manual. The drawings included five of 90-deg. crossing signs for suspension over a highway, with or without reflector buttons, showing details and assembly plans, and an additional drawing showing the recommended method of mounting the 90-deg. railroad crossing signs.

All six drawings submitted by the committee were approved for inclusion in the Manual, without comment.

"Gates-Not-Working" and "Watchman-Not-on-Duty" Signs

For adoption and inclusion in the Manual, the committee presented, without comment, two drawings covering a "Watchman-Off-Duty" sign of the reflector type, and two drawings covering a "Gates-Not-Working" sign of the reflector type. In addition, it presented for adoption a drawing of a recommended metal cover plate for signs, intended to be placed over signs, the meaning of which is to be temporarily nullified.

In presenting this part of its report, the committee withdrew its recommendation that the various sign design drawings submitted be approved for adoption. It pointed out that further study of the size and spacing of lettering on the signs seemed advisable, and that following consideration in this regard, it would resubmit the drawings next year for adoption.

Railway-Highway Grade Crossings

In considering the design of and specifications for highway

* Engineer Grade Crossings, Association of American Railroads.

crossings at grade over both steam and electric railway tracks, the committee has been collaborating with the Committee on Roadway, the American Society of Municipal Engineers, and the American Transit Association. Its report this year dealt exclusively with pre-cast concrete slab crossings, for which it presented detailed specifications, which it recommended for adoption and publication in the Manual. These specifications deal primarily with the track structure at crossings, with specific reference to width of crossing and approaches; the design, materials used and installation of pre-cast concrete crossing slabs; flangeway and filler blocks; shims and beveled strips; and elevation of the top of rail and pavement. Under design, materials and installation, the specifications cover loading, design, armor, flangeways, outside of rail head, anchorage, variable depth, beveled end slabs, concrete, steel and ties.

The specifications were adopted without discussion.

Barrier Type of Protection, Including Gates

Collaborating with the Signal section, A.A.R., the committee, under this assignment, gave particular attention to automatic crossing gates. As a result, it presented as its report, as information, a series of 14 requisites for the construction, installation and operation of automatic gates. More specifically, these requisites have to do with the aspect presented by the gates, the position of the gate arms, the size of warning bell employed, the mounting of the gate arms, the design and operation of the gate mechanism, electrical circuits, approach warning devices, operation of arms, warning bell and flashing lights, and lamp units and their location.

Other Subjects

The committee presented an outline of the complete field of its work, and reported progress in the study of the following additional subjects: Economic aspects of grade crossing protection in lieu of grade separation; comparative merits of various types of grade crossing protection; difference in costs of highways of various types due to different weights and lengths of trucks; and methods of classifying grade crossings with the respect to hazard.

Report on Economics of Railway Location

F. R. Layng, Chairman*

The report of the committee dealt almost exclusively with the revision of the Manual. However, it was reported that progress had been made in the study of two other assignments.

Revision of the Manual

In its study of desirable changes in material in the Manual, the committee this year confined its attention to that part relating to "Power". As new material, the committee presented for consideration and future adoption, definitions of a number of fundamental factors which are common to all types of locomotives. These factors are tractive effort, horsepower, locomotive capacity, adhesion limit, maximum tractive effort, maximum horsepower, available horsepower, and source of power.

The committee gave consideration to revising the material in the Manual with regard to steam locomotives, but found that data similar to that in the Manual on this subject is receiving widespread attention by a number of other interested parties, including the locomotive builders and the Research bureau of the Association of American Railroads. In view of this situation, it felt that it would be desirable for it to postpone revision of the Manual as regards steam locomotives until it can have the benefit of the studies and conclusions of those others who are now giving this subject careful consideration.

The new Manual material proposed by the committee was presented as Exhibit B, and covered both the direct current and the alternating current systems of electrification and the following present types of electric locomotives: Direct current locomotives; single phase (alternating current) locomotives; split-phase induction motor locomotives; and single-phase motor generator locomotives.

In the body of the proposed Manual material, the committee first discussed the difference between steam and electric locomotives, giving attention to locomotive capacity, adhesion limit, wheel arrangement, and horsepower rating of electric locomotives, and then discussed the tractive effort and horsepower of the four different types of electric locomotives. This latter part of its discussion was supplemented with characteristic curves and with forms for calculating the tractive effort and horsepower output of typical electric locomotives of the various types. The final part of the material submitted by the committee had to do with a comparison of steam and electric locomotive performance.

Other Subjects

The committee reported progress in the study of its two other assignments as follows: Operating data essential to establish units for making line and grade revisions to meet operating requirements; and the effect of speeds in excess of 75 m.p.h. on the

This report was received without discussion.

* Chief Engineer, Bessemer & Lake Erie.

Iron and Steel Structures

G. A. Haggander, Chairman*

Aside from preparing an outline of the complete field of its endeavor, the committee reported in detail upon only one of its assignments, this having to do with the application of and specifications for fusion welding and gas cutting as applied to steel structures. However, the committee reported progress in the study of all eight of its other assignments.

Fusion Welding and Gas Cutting of Steel Structures

Collaborating with Committee A-1 on Steel of the American Society for Testing Materials, the committee gave consideration during the year to the application of fusion welding and gas cutting to steel structures and to specifications for this class of work. However, it confined its report entirely to the subject of application, discussing both the electric arc and gas processes. As regards the present status of welding and the different processes, the committee reported as follows:

"Until recently, specifications for steel bridges forbade or discouraged the use of welding. Because of the advance in the knowledge and art of welding, particularly arc welding, the production of filler metal of a superior grade, and the development of fluxed electrodes, reliable welds may now be secured and definite results obtained by qualified welders working under careful procedure control.

"Gas welding and cutting have been in use for a number of years, practically every railway maintenance organization being provided with the requisite equipment and having crews familiar with its use. The gas process has the advantage of requiring lighter, less expensive, and more easily transported equipment than the arc process. It has the disadvantages of slower operation and requires the heating of a larger amount of the base metal. It should not be used for welding parts while under stress as there may be danger of permanent distortion. Arc welding should be used for work of considerable magnitude. At present, arc welding is usually done with direct current, but the use of alternating current is increasing because of its greater availability."

Continuing its report, the committee then discussed in some detail materials, types of welds, stresses, locked-up stresses, concentrated stress, economy, qualification and tests, inspection, new construction, and the repair and reinforcement of existing structures.

As a result of its study, the committee presented the following conclusions:

"It is apparent that the practice of welding is in advance of theory and somewhat ahead of exact knowledge. There is a large field for research and experimental work and a great deal is being done in all parts of the world. So much knowledge is now available that there need be no hesitation in applying welding in repair and reinforcement work. All-welded work should be adopted only after a thorough study, both technical and economic.

"Consistent specifications should be adopted and enforced

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rigidly. Qualified operators and experienced inspectors should be employed. It is particularly necessary that the work be designed and the sequence of welding operations be outlined by a competent engineer experienced in fabricating welded steel structures.

"The 'Specifications for Design, Construction and Repair of Highway and Railway Bridges by Fusion Welding' of the American Welding Society, published in 1936, cover in detail the materials, equipment, processes, workmanship and inspection of gas and arc welding as applied to bridgework, new and old. These specifications may be obtained from the American Welding Society."

In presenting this portion of the report, Chairman Haggander called attention to the need for more complete information concerning the behavior of welds subject to reversals of stress and asked that this subject be given mature consideration in any plans for expanding the scope of research work conducted under the auspices of the association.

Other Subjects

Other subjects considered by the committee during the year but not reported upon in detail are as follows: Revision of the Manual, with special consideration to the specifications for movable railway bridges; design of rivet heads for steel structures; stresses in wire rope bent over sheaves; different grades of bronzes to be used for various purposes in connection with iron and steel structures; design of expansion joints involving iron and steel structures; design of tension members and connections in which rivets develop tension; effect of proposed increase in vehicular weights on highway bridges; and review specifications for overhead highway bridges of the Association of State Highway Officials insofar as they relate to steel construction.

Report on Economics of Bridges and Trestles

Arthur O. Ridgway, Chairman*

During the year the committee carried forward its study of the comparative economic value of steel, treated timber and concrete in bridges, trestles and viaducts under various conditions of service, giving due consideration to the relative influences of durability of materials and obsolescence of property. In a detailed report on this subject, it discussed each of the various factors which must be taken into consideration in arriving at a sound and complete answer to this question, and then presented a series of three conclusions, embodying its recommendations, which it offered for adoption and inclusion in the Manual. These conclusions are reprinted in full in the following:

"(1) The comparative economic value of steel, treated timber and concrete in bridges, trestles and viaducts is determined by comparing the annual cost of structures built of the respective three kinds of material. The annual cost of any such structure may be ascertained by the equation,

$$A = Cr + \frac{C'r'}{(1+r')^n - 1} + M + I + T \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

in which

A = the annual cost of the structure.

C = initial cost of structure, including cost of removal less salvage of existing structure, if any.

C' = cost of replacement of the structure in kind at the end of its serviceable life, including cost of removal less salvage value of structure replaced. If a structure is to be retired and not replaced in kind at the end of its serviceable life, then $C' = C$ for extinguishing the investment.

r = annual rate of interest throughout the n year period.

r' = annual rate of interest on sinking funds.

n = serviceable life of the structure in years as determined by:

1. Deterioration.
2. Change in tracks, grade or alinement.
3. Change in character and volume of traffic or type and weight of equipment.
4. Replacement with different type of structure.
5. Abandonment of line.

M = annual expenditure throughout its serviceable life for repairs, inspection, policing, fire protection and keeping structure to established standards of surface and line.

I = annual expenditure for any and all forms of insurance properly chargeable to the structure whether provided for through risks assumed by owner or policies purchased outright.

T = annual expenditure for taxes of every kind which should be properly allocated to the structure, the inference here being that every facility of a railway should bear its share of assessments however they may be levied.

"The demands of functional use are fixed for a particular site regardless of structural type, and, therefore, if each of the three kinds of material fully meets all these essentials, annual cost is the sole criterion in comparative economic value. In formulating the service requirements at a particular site, consideration must be given to the following governing factors:

UTILITY

(a) Frequency and speed of trains.
(b) Character and volume of both passenger and freight traffic.
(c) Discharge characteristics of stream or character and volume of traffic over which rail traffic is carried.

SECURITY

(a) Immunity from speed restrictions for making structural repairs or adjustments in line and surface.
(b) Freedom from detentions due to damage or destruction, either partial or complete, by fire, flood or other casualty.
(c) Adequate reserve strength to accommodate occasional higher speeds and heavier loads.

APPEARANCE

(a) Frequency of observation.
(b) Apparent fitness for functional use.
(c) Prominence as a setting in immediate surroundings.
(d) Harmony with natural or established artificial features of landscape.
(e) Apparent permanence and durability.
(f) Stability of form and shade of color during serviceable life.

"(2) The service requirements of a bridge, trestle or viaduct being peculiar to its site, precise determination of annual costs necessitates separate designs for each site.

"(3) No comparison can be made of the economic value of materials that cannot be adapted to the complete fulfillment of service demands."

The conclusions recommended by the committee were approved for publication in the Manual.

* Chief Engineer, Denver & Rio Grande Western.

Yards and Terminals

M. J. J. Harrison, Chairman*

Five subjects were reported upon in some detail by the committee, including hump yards, scales, and expediting freight car movements through yards, while progress was reported in the study of two other subjects.

Expediting Freight Car Movements Through Yards

After referring to its report on this subject, presented at the convention in 1934, and calling attention to the many more recent studies of this transportation problem made by individual railways, groups of railways, and by both private and governmental agencies, the committee pointed out that practically all of these studies have served to emphasize the great importance of the movement of cars through yards and terminals and the effect thereof on both time and costs. It reported that it has under way the collecting of information as to the practices and experiences of individual roads in coping with this most difficult problem, and is endeavoring to bring up to date some of the material presented on this subject heretofore.

As a result of its studies, the committee said that it is still of the opinion that the problem is primarily one of operation, since, with even modern facilities, there are serious delays which seem avoidable. In its opinion, one of the greatest sources of delay is that incident to the inspection of equipment, particularly at in-

* Retired General Scale Inspector, Pennsylvania.

terchange points, and it suggested that the proper division or divisions of the Association of American Railroads give serious consideration to this matter.

Scales Used in Railway Service

The committee reported that experience in the application of the specifications for the manufacture and installation of two-section, knife-edge railway track scales, adopted by the association in 1927, has suggested certain desirable revisions in these specifications. As a result, it presented in its report of this year, as information, a new set of tentative specifications which incorporate the desired revisions, and which also follow the form of other specifications adopted more recently by the association.

The new specifications, which the committee hopes can be submitted to the association in 1938 as a substitute for the existing material in the Manual under this same title, cover the subject under the following heads: Introduction, capacity, plans, working stresses and formulas, length of scale, scale levers, pivots and bearings, nose irons, lever fulcrum stands, loops and connections, checks, weighbeams and accessories, anti-friction points and plates, clearances, interchangeability, scale weighbridges, transverse beams supporting approach rails, protection from corrosion, approach rails, deck, exclusion of dirt and precipitation, lighting, location and elevation, foundation and pit, setting of the scale, weighbeam house, sensibility reciprocal, and tolerance.

Hump Yards

In view of the fact that the designing or building of a gravity or hump classification yard, or the converting of such a yard from rider to retarder operation, is such a relatively infrequent engineering problem, the committee felt that an outline of the features involved should be of value to railway engineers in preparing plans or estimates for such a project. Accordingly, it prepared and presented as its report such an outline, including all features which should be given consideration. This outline is set up under the main heads, track layout, accessory features, operating facilities, communication, rider facilities, retarder capacity, and retarder facilities.

Bibliography

The committee again presented a bibliography of published articles, papers and books dealing with subjects relating to its work, including passenger stations and terminals; freight stations, terminals and yards; rail-and-water terminals; and miscellaneous subjects. The bibliography includes 252 items.

Other Subjects

In addition to the foregoing subjects reporting upon, the committee presented an outline of its complete field of work, and reported progress in its study of revisions of the Manual and of the proper widths of freight house and team yard driveways.

The report was accepted without comment.

Wood Bridges and Trestles

H. Austill, Chairman*

The committee presented progress reports on five of its assigned subjects, and submitted for adoption and publication in the Manual a plan for a ballasted deck trestle for E-72 loading, together with a table of stresses in the members of such a trestle with various span lengths and stringer sizes.

Wood Trestles for Heavy Loading

After reviewing again during the year the plan submitted for criticism last year for a ballasted deck trestle for E-72 loading, the committee presented this plan for adoption and inclusion in the Manual. The only change in the plan as re-submitted has to do with the bracing, which was revised to conform with the method of bracing provided for in the plan for open deck trestles for E-72 loading, which was approved by the association in March, 1936. The committee also submitted for adoption a table, first submitted as information in 1935, showing the stresses developed in the limited members of a ballasted deck structure with various span lengths and various stringer sizes.

B. R. Leffler (N. Y. C.) objected to the design on the ground that the committee should have given more consideration to the lateral forces which act upon trestles and suggested that the subject be given further study before the plan is presented for adoption. He said that investigation has shown that lateral forces acting at the level of the rail tend to shift the load from one pile to another and that at times they become of sufficient magnitude to throw the entire load onto the batter piles.

J. B. Hunley (C. C. C. & St. L.) raised a question with respect to the difference between the longitudinal bracing on open-deck and ballast-deck trestles as shown on the plans, and suggested that further study be given to the subject of this bracing. He was supported in this by Mr. Leffler, who contended that these differences were not warranted and that as designed the bracing is likely to catch drift during periods of high water, not only causing an obstruction to the flow through the trestle but creating a fire risk after the water subsides.

W. A. Radspinner (C. & O.) questioned the adequacy of the fire stops provided by present plans for wood trestles and suggested that the committee study this subject with a view to making recommendations for amending the present requirements.

H. M. Church (C. & O.), chairman of the subcommittee, objected to changing the plans at this time in view of the long study given to their preparation and in further view of the fact that the suggestions which had been made constituted a considerable departure from accepted practice and would, therefore, delay adoption of any plan. For these reasons he moved the adoption of the plan as presented, which motion carried.

Bearing Power of Wood Piles

In a brief progress report, the committee called attention to the fact that it is preparing a bibliography of material on the bearing power of piles, copies of which, in its present state, may be secured from the secretary of the association. It pointed out that this bibliography supplements the material on piles which appeared in the Bibliography of Physical Properties and Bearing Value of Soils, prepared by Morris Schrers, and published in the proceedings of the American Society of Civil Engineers for August, 1931.

Relations Between Hammer and Weight or Mass of Pile

The committee continued its study of this subject during the year, but confined its report to a brief resumé of the International Conference on Soil Mechanics and Foundation Engineering, held at Harvard University on June 22 to 26, 1936. More than 150 papers were presented at the conference, at which two of the committee members were in attendance.

Facts stressed at the conference, which were of particular interest to the committee, were the need of settlement observations of full-size structures, such as buildings, embankments and bridge piers, and also for observations of pressures on and movements of retaining walls and sheeted cuts over long periods of time. Such observations, it was pointed out, are desired so that the theoretical analysis of the action of structures may be modified and fitted to practical use in the design of future structures.

Another fact stressed was the danger of using empirical formulas for the bearing value of piles, without a study first being made of the soil underlying the bottoms of the piles. In concluding its report, the committee listed references to printed discussions at the conference and also to certain basic works on soil mechanics.

Improved Design of Timber Structures

In a report submitted as information, the committee discussed the disadvantages of the present plans in the Manual for five or six-pile and four or five-post frame bents, particularly from the standpoint of employing treated timber, and pointed out that when treated material is used, it is imperative that cutting and boring of the timbers in the field should be held to the minimum.

As a result of its study, the committee presented a plan for a five and six-pile open deck trestle, wherein the stringers are skewed slightly with the center of the track, or, as termed "lap chord" arrangement. With this design, it was pointed out, it is in no case necessary to cut a stringer at the ends. It was also pointed out that a larger bearing area is obtainable on the caps, and that using a single span stringer is more economical in handling and in erection. Referring to the plan, attention was called to the design of stringer fastenings over the caps, which can be used to avoid the use of drift bolts in the stringers. The com-

* Bridge Engineer, Mobile & Ohio.

mittee pointed out that the stay rods have proven very satisfactory with the design of deck employed; in fact, that they appear to hold the stringer more firmly than drift bolts, resulting in less maintenance to hold the deck in proper alinement.

The plan submitted also includes a concrete bulkhead, which is an improvement over the present wood bulkhead, in that it is fireproof and requires practically no maintenance.

A second plan submitted by the committee shows an improved method of preparing and boring holes in caps, fenders and ties for open deck bridges. All timbers shown on this plan are covered by a marking diagram and general notes.

Supplementing these plans, the committee submitted tables showing a comparison of unit stresses for a selected number and size of stringers for open deck trestles. These tables also give the two methods of computing horizontal shear in the stringers. The different tables are based on Cooper's loadings of E-52, E-56, E-60, E-64, E-68 and E-72. It was pointed out that for the stresses and span lengths shown in the tables, the most desirable and economical stringers and bents can be selected or worked out.

Specifications for Overhead Highway Bridges

The committee reported that it had reviewed the specifications for overhead highway bridges of the Association of State Highway Officials in-so-far as they relate to wood construction, but was not in a position to make a report other than to say that it found some features which are not approved, and not entirely in line with the specifications of the A.R.E.A.

Other Subjects

Other subjects considered by the committee during the year, but not reported upon, were, revision of the Manual; simplification of grading rules and classification of timber for railway uses; and overhead wood or combination wood and metal highway bridges.

Water Service, Fire Protection and Sanitation

R. C. Bardwell, Chairman*

Although actively engaged during the year in the study of all of its 12 assignments, the committee made detailed reports on only 7, reporting progress in the study of the other 5 assignments. For various reasons, it recommended that the study of 4 of its assignments be discontinued.

Relation of Railway Fire Protection to Municipal and Privately-Owned Waterworks

In a report based largely upon answers to a questionnaire submitted to a considerable number of railways and to engineers of the fire underwriters, the committee gave attention exclusively to charges made by municipal and privately-owned waterworks for "stand-by" fire protection service. Answers to the questionnaire revealed that there are very little data concerning fire service charges available for comparative purposes, and that, in some cases, the railways were not sure of what rates they were paying in the way of "stand-by" charges.

Commenting upon this subject, the committee said, in part, as follows:

"Public fire protection is a governmental function and for such service public fire departments, consisting of apparatus and men, are maintained by municipal funds obtained from the general tax levy. In the case of a private water company, the municipality pays direct for fire protection service. There appears to be a question as to whether some railways are receiving the service to which their tax payments entitle them.

"As a condition precedent to allowing a 'stand-by' or 'readiness-to-serve' charge, or the fixing of the amount of such charge, it should be shown definitely that the waterworks incurs a cost on standing-by to provide private fire protection, and the nature and amount of such cost, if any."

Referring to information brought together in 1930 by means of a questionnaire, the committee pointed out that practically all of the large cities of the United States, and the majority of the smaller communities, where the waterworks are municipally owned, have adopted the principle that when the property owner pays all installation costs, including that of the water connection, either no charge at all is made, or only a nominal charge sufficient to cover the cost of maintenance and inspection.

On the other hand, the information collected indicated that a few of the municipally-owned waterworks and some private water companies levy charges which are so high that they discourage the installation of private fire protection equipment. These charges appear to be on a more or less arbitrary basis, depending upon the size of connections, the number of hydrants, or the number of sprinkler heads.

Following a statement of the annual charge made for a six-inch "stand-by" fire connection in a considerable number of the larger cities of the country, the committee commented as follows:

"The railways may be interested in checking the price they are now paying against those shown in the accompanying list. One system has found that it pays $3,098 annually for the right to use its own fire fighting facilities, which it has paid for, installed and maintained to protect its property more thoroughly, and to assist the waterworks companies and help protect adjoining property not its own." The committee pointed out that such conditions are the same as double taxation, in support of which it quoted certain court decisions.

At the end of its report, the committee presented a group of conclusions arrived at by the National Firewaste Council, and included in its pamphlet entitled "Water Charges for Public and Private Fire Protection." These agreed with the contentions of the committee.

This report was received as information.

Use of Phosphates in Water Treatment

In fulfilling its assignment on this subject, the committee collected information from widely scattered sources concerning the properties and value of phosphates in treating water for locomotive boiler use, and then compiled the information in convenient form and submitted it as the substance of its report. It stated that the use of tri-sodium phosphate for the prevention of scale in steam boilers is definitely recorded as early as 1886, and that there are now eight different phosphates of soda used for this purpose.

In commenting upon the data which it compiled and submitted, the committee said as follows:

"This report does not attempt to compare phosphates with other chemicals for water treatment. However, phosphates of soda have a distinct and undeniable place in the treatment of boiler feedwater. They are not a panacea and must be used with judgment based on the inherent characteristics of the several phosphates available, the characteristics of the raw water available, the size of the boiler plant involved and the percentage of makeup water required."

This report was received as information.

Pitting and Corrosion of Boiler Tubes and Sheets

During the last year the committee reviewed what information has been made available to it from the railways and the Joint Research Committee on Boiler Feedwater Studies, and reported, in part, as follows:

"Results of the Joint Research Committee's investigation to date indicate that the type of boiler cracking, known as embrittlement, is dependent upon the combination of two contributing causes, namely, boiler metal under stress and the character of feedwater. Specific information has been obtained on data relative to the solubility deposition of sodium sulphate or its complex salts in boiler waters.

"It is believed by these research workers that under certain conditions a combination of sodium silicate and sodium hydroxide tends to promote embrittlement and that sodium sulphate tends to inhibit this effect in some cases. Their studies also indicate that some oxidizing salts, such as sodium chromate, may have an inhibiting effect on embrittlement.

"As a result of the investigations reported during 1936, it is believed that the development of two factors by the Joint Research Committee may lead to a method of retarding embrittlement of boiler metal. One of these factors has been expressed in a curve showing conditions under which sodium sulphate will be deposited from waters of known composition when such waters are evaporated in a boiler. If further investigation proves

* Superintendent of Water Service, Chesapeake & Ohio.

that sodium sulphate, either in solution or as a solid, is necessary to prevent embrittlement, this investigation will define the conditions that should be maintained. Their research also indicated that caustic soda alone will not produce embrittlement. Another factor which has been substantiated by individual railroad laboratories, and which is being studied further, is the presence of "metal fatigue" or "age embrittlement" which may have a decided effect on further studies of this problem."

Analysis of Chemicals Used in Water Treatment

Under the head of sulphate of alumina, the committee presented in detail methods for the determination of the total iron and aluminum oxides, total iron, water soluble aluminum oxide, and basicity, all of which it recommended for adoption and inclusion in the Manual. It also presented two methods, the rapid method and the precision method, for analyzing the salt to be used in the regeneration of zeolite water softeners. It recommended that this latter material be received as information.

The material recommended for inclusion in the Manual was adopted without discussion.

Regulations Pertaining to Railway Sanitation

The report on this subject was essentially a report of a meeting of the Joint Committee on Railway Sanitation held in New York on September 22, 1936, and the circumstances which brought about this meeting. The Joint committee consists of representatives of the Engineering division, the Medical and Surgical section, the Mechanical division, the U. S. Bureau of Public Health Service and the Canadian Health Department.

The committee explained that the meeting of the Joint committee was called, following a complaint by one of the U. S. Public Health Service members of the Joint committee that relatively little attention is being paid by the railways to the report of the Joint committee, published as information in 1931 for the guidance of member roads. The letter of complaint expressed the hope that the Joint committee might influence the engineering departments of the various railways in charge of design and construction, to follow the recommendations of the committee to the end that the necessity for federal regulation would not exist. The committee stated that the Joint committee is asking all member railways to review the report sent out in 1931 and to submit any recommendations, changes, or suggestions they may have to offer, to the end that the report may be kept in line with modern practice and its importance emphasized as a practical guide for those departments of the railways having to deal with local, state and federal sanitary regulations.

Reduction of Water Waste

After introducing its report with cost figures indicating that water is one of the most extensively used and expensive commodities used by the railways, the committee emphasized the large possibilities for saving through the reduction of leakage, excessive use and waste. In this latter regard it cited the results of an intensive campaign on the Illinois Central to save water. These results showed that whereas the expense to the railway for city water in the fiscal year 1913-1914 was $225,112, it was reduced to $190,438 in the fiscal year 1914-1915, a saving of $34,674.

In the main body of the report, the committee discussed the more important sources of water waste and then, for the convenience of those studying the report, listed these more common sources. This list includes 35 items. It pointed out that all of these sources of waste might be corrected by good maintenance, investigation of underground leakage, visible overflow outlets, close attention to plumbing fixtures, the re-use of cooling water where practicable, the instruction of employees in methods of avoiding water waste, and publicity on this subject. At the end of its report, the committee offered the following conclusions:

"1. Constant vigilance is required on the part of employees and supervisory forces to save water.

"2. A system of daily or weekly meter readings should be maintained by the plant engineer or other competent employee at terminals where meters are used. Comparison of these readings should be made and any unaccounted-for increases investigated promptly. Sectional metering for large terminals is advisable.

"3. Water waste prevention publicity, consisting of placards, water cost statements and frequent instructions to employees are necessary to conserve water. Otherwise, water which is usually considered "free," will be used wastefully.

"4. Overflow pipes from roadside and washout tanks, water column pits and other fixtures having concealed sewer connections, should be examined frequently for waste. Visible overflow outlets should be provided where practicable.

"5. Hidden leakage in underground mains should be suspected when an otherwise unaccounted-for increase in water consumption takes place and the necessary excavation and repairs should be made to the pipe joints.

"6. The installation and maintenance of oversized connections should be avoided. Adequate sizes are more economical from water-waste and maintenance standpoints. Improved pressure is also secured by the reduction of unnecessary openings."

The committee recommended that the report be received as information.

Other Subjects

The committee presented an outline of the complete field of its work, and reported progress in the study of the following subjects: Revision of the Manual; value of water treatment with respect to estimating and summarizing possible savings effected; clarification and disinfection of smaller railway drinking water supplies; and classification of water service material.

Report of Committee on Roadway

Geo. S. Fanning, Chairman*

The committee gave consideration to eight subjects during the year, presented progress reports on three having to do with the physical properties of earth, roadway drainage and roadway signs, and submitted a final report on roadway protection. In addition, it submitted specifications for cast iron culvert pipe, which it recommended for adoption and for publication in the Manual.

Physical Properties of Earth Materials

The report on this subject was essentially a brief resumé of material presented before the first International Conference on Soil Mechanics and Foundation Engineering, held at Harvard University on June 22 to 26, 1936. This conference was attended by more than 200 engineers of the United States and 18 foreign countries, and its program included 156 papers. In referring to these papers, the committee grouped them under the following heads:

Reports from Soil Mechanics Laboratories on Testing Apparatus, on Technique of Testing and Investigations in Progress
Exploration of Soil Conditions and Sampling Operations
Regional Soil Studies for Engineering Purposes
Soil Properties
Stress Distribution in Soils
Settlement of Structures
Stability of Earth and Foundation Works and of Natural Slopes
Bearing Capacity of Piles
Pile Loading Tests
Earth Pressures Against Retaining Walls, Excavation Sheeting, Tunnel Linings, etc.
Ground Water Movement and Seepage
Soil Problems in Highway Engineering, Including Frost Action in Soils
Methods for Improving the Physical Properties of Soils for Engineering Purposes, Including Recent Developments in Constructing and Compacting Earth Fills
Modern Methods of Design and Construction of Foundations

Culvert Pipe

The committee gave consideration to factors involved in determining the location and type of culverts, the service life of culverts, and to specifications for cast iron culvert pipe, but it made a report on only the last-mentioned subject. In this regard, it presented for adoption and inclusion in the Manual, without comment, the specifications for cast iron culvert pipe of the American Society for Testing Materials, designated A 142-35T.

* Chief Engineer, Erie.

These specifications cover the subject under the following main heads: Classes and type of pipe; manufacture; chemical properties and tests; physical properties and tests; sizes; weights and permissible variations; workmanship and finish; weighing and marking; and inspection and rejection.

In answer to a query concerning how the proposed classification compares with the present classification, the chairman replied that this was given in detail in last year's report. Some objection was voiced concerning the resistance to the test loading specified. The discussion then turned to whether the specification should be adopted, in view of its tentative status with the A.S.T.M.; and to whether specifications taken bodily from other associations should be printed in the Manual. The specification was approved for inclusion in the Manual, with the stipulation that a footnote be printed stating that it is identical with A.S.T.M. Specification A142-35T.

Roadway Drainage

In a brief progress report, the committee advised that, having completed its handling of this subject for the Manual, it is now studying the adherence to its recommended practices and progress in the science and art of roadway drainage. It continued its efforts to "sell" proper roadway drainage to the railways, and again urged maintenance men on every road to study the recommended practices with the view of offering criticisms and suggestions, or of supplying information as to new developments in roadway drainage.

Roadway Protection—Concrete Roadbed

The committee reviewed briefly the reports of A.R.E.A. committees on this subject since 1920, giving a brief history of the installations covered, and then summarized its own opinions and recommendations in the following conclusion, which it recommended be approved for inclusion in the Manual:

"The protection of the roadbed from deformation caused by increasing track loads has been effected by the use of concrete slabs. Designs vary with the theories of the desirability of more or less resiliency or of absolute rigidity of the track structure.

"(A) The type of construction which preserves the resiliency of ordinary ballasted track while attempting to correct the faults of an unstable roadbed consists of a concrete slab, plain or reinforced as the foundation conditions require, cast directly on the roadbed, upon which ordinary ballasted track is constructed. Such construction greatly increases the bearing power of natural ground, supplies a continuity of bearing, prevents settlement back of bridge abutments and at soft spots, eliminates vibration and waving of track over saturated ground, and reduces the pounding of frogs and crossings. The use of this construction is recommended for heavy traffic track, particularly at stations, yards, turnouts and crossings, and at soft spots and elsewhere where maintenance costs are unusually excessive. Obviously, it does not eliminate maintenance costs arising in connection with the renewal of ties and ballast, or all costs for lining and surfacing track.

"(B) A type of construction which preserves some of the resiliency of the track and at the same time eliminates the expense of ballast cleaning and renewals and, if successful, the cost of lining and surfacing track, consists of a concrete slab with embedded timber blocks which carry the rails. Any disturbance of the soil under this type of concrete slab construction, due to shrinkage of the ground, saturation, or heaving from frost, is disastrous to line and surface; an absolutely stable foundation seems essential. Another objection arises from the difficulty of making changes in the track, such as the introduction or removal of turnouts and the impossibility of changing its line or grade; permanency of location is a prerequisite of a permanent roadbed. For these reasons, this type of construction has been successfully used only in large terminal stations, tunnels and subways. For such locations it has the following advantages: (1) more satisfactory drainage; the center drain trough between tie blocks eliminates many under-drains; (2) better riding qualities due to permanency of alinement and grade, with resulting favorable effect on equipment; (3) better maintenance conditions; the frequency of train movements makes maintenance of ballasted track difficult and very expensive; (4) better sanitation and easily kept clean; (5) increased safety by reducing to a minimum the number of workmen required to maintain track; (6) economy of maintenance, requiring only the renewal of rail and tie blocks. Consideration must be given, however, to the possible effect of ground waters on the concrete.

These conclusions were approved.

"(C) The ultimate type of concrete roadbed is one which eliminates all track maintenance costs except the renewal of rail due to normal wear. This would require the rails to rest directly on the concrete. However, the experimental installations on the Pere Marquette at Beech, Michigan, indicate that rapid battering of the rail at the joints will result unless some cushioning material (such as oak plank) is placed under the rail, or unless the joints are butt-welded. The cost of construction of this type of roadbed makes its use prohibitive except at locations where the cost of maintaining ordinary track is unusually high, such as at large terminals and in tunnels and subways.

In constructing tunnels and subways, the continuous support of the rail on a cushioning plank instead of ballast and ties involves less construction expense, saves head room and, especially when combined with the butt-welding of rail joints, offers the possibility of reducing track maintenance to a minimum."

Roadway Signs

In a progress report, intended to invite criticism and suggestions, the committee presented a series of notes on roadway sign requirements, principles of design and rules for use, and the economy of various materials. Under principles of design, the committee offered the following comments:

"Distinguishing shapes of signs make recognition possible from distances too great to decipher legends on the signs.

"Dimensions of signs may be diversified as are shapes, within limits determined by the legend.

"The body of the sign (ground) is best in sharpest contrast with the lettering. Black letters on white ground show best against the greens and browns of foliage and earth. With a white background, such as snow, the post as well as the sign should be dark, preferably black, with white or perforated characters.

"Legends on signs preferably should be short, consisting of characters that are as large, as plain, and as widely spaced as necessary for legibility at the required distance. Care should be observed to diversify, as well as to minimize the characters on signs of similar classes and forms. Dark colors, preferably black, are recommended for the characters of legends. Proper spacing of characters is best determined by field tests. Bold stroked block letters are preferable."

In considering the economy of various materials, the committee presented the advantages and disadvantages of untreated and treated wood signs, scrap rail and scrap boiler tubes for sign posts, scrap plate signs, sheet steel signs purchased to specification, cast iron signs with raised letters, flexible aluminum signs, and reinforced concrete signs. It pointed out that oil paints are most commonly employed for painting signs, but said that enamel lasts longer unless misused, when it cracks and breaks.

Other Subjects

Progress was reported on the following subjects: Natural waterways, with particular reference to drainage areas, runoff and size of openings; the service life of culverts; the formation of the roadway, with particular reference to width of roadbed and angle of slopes; specifications for the construction of tunnels; and railway fence construction.

Complete Roadway and Track Structure

John E. Armstrong, Chairman*

The committee, formed in 1934, continued during the last year to study complete roadway and track structures for various loads and traffic densities, and also the classification of railways, but stated that it was not yet in a position to make a report on either of these subjects. As pointed out in its brief report at the convention in 1935, the committee, as regards its study of complete roadway and track structures, is basing its work largely upon the data which have been developed by several fundamental committees of the association. For several widely used or accepted

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rail sections, the committee plans eventually to develop complete track structures, with due consideration given to traffic density, loads, speeds and other influencing factors.

This report was presented by title only.

Report on Ballast

A. D. Kennedy, Chairman*

Most of the work of the committee during the year was in connection with subjects related to revision of the Manual, but, in addition, it prepared for submission for adoption specifications for stone ballast, submitted originally last year, and furthered its study of the design of ballast sections best suited to present-day requirements.

Specifications for Stone Ballast

In lieu of the present specifications for stone ballast, adopted in 1931, and revisions thereto, the committee presented for adoption new specifications for stone ballast. Fundamentally, the new specifications are the same as those submitted last year as information; however, the committee called special attention to added material on test specification limits, which is intended to give an idea of the proper test limits for use in specifications for different classifications of stone ballast. The new specifications are drawn up under the following main heads: General characteristics, gradation in size, deleterious substances, physical requirements, quality requirements, absorption, toughness, percentage of wear, soundness, frequency of testing, selection of samples, averaging of test results, place of tests, specification limits, production requirements, handling, cleaning, defect found after delivery, inspection, measurement, and methods of test.

The specifications were adopted.

Revision of Manual

In the specifications for prepared blast furnace slag ballast, adopted last year for inclusion in the Manual, the committee recommended changing the table of gradation to conform with the gradation table in the new specifications presented this year for stone ballast. In the same specifications for slag ballast, under "Production Requirements," paragraphs (e) and (f), it recommended that the term "manufacturer" be changed to "producer."

These changes were approved.

Proper Depth of Ballast

Since the convention in 1936, when all of the material under the subject of proper depth of ballast in the Manual and subsequent revisions thereto was withdrawn, the committee has given renewed consideration to this subject. It was not in a position to make definite recommendations this year, but advised that a questionnaire on the subject had been addressed to the chief engineers of all Class I railroads in the United States and Canada. Replies were received from roads representing approximately 100,000 miles.

Based on these replies, the average maximum and minimum depth of ballast recommended by the roads for the three classes of track which would nominally call for 131-lb., 112-lb. and 90-lb. rail, respectively, are given in the following table:

	131-lb.		112-lb.		90-lb.	
	Max.	Min.	Max.	Min.	Max.	Min.
Top Ballast	16 in.	12 in.	14 in.	11 in.	12 in.	10 in.
Sub-ballast	14 in.	10 in.	**13 in.**	**10 in.**	**12 in.**	**10 in.**
Total Depth ...	30 in.	22 in.	27 in.	21 in.	24 in.	20 in.

In presenting this matter, Chairman Kennedy emphasized the fact that this table did not represent the recommendations of the committee, since the data on which it is based are not sufficiently conclusive. He added that the committee hoped to gather more complete information on which a specific recommendation could be based.

Los Angeles Testing Machine

The committee gave considerable study during the year to the Los Angeles testing machine, a device for determining the abrasive resistance of crushed stone, slag and gravel. It pointed out that indications are that the use of this machine will probably replace the Deval test, which is now considered standard, in which event, the ballast specifications of the association will have to be adjusted accordingly. In view of the increasing popularity of the Los Angeles testing machine, the committee presented as a part of its report a full description of the machine, together with pertinent data concerning methods of test and actual tests themselves.

At the end of its report, the committee offered the following conclusions:

"The Los Angeles rattler test is decidedly more suitable for determining the hardness and toughness of rock and the amount of soft material than any test or group of tests studied. Its advantages are pointed out as follows:

(a) The nature of the treatment is severe, bringing out weaknesses not shown by any one of the other tests studied.

(b) It is adapted for testing both crushed stone and gravel aggregates.

(c) It requires very little time for performance.

(d) It is not affected materially by changes in the volume of aggregate due to specific gravity because of the size of the cylinder in which the test is made.

(e) It eliminates a large amount of the personal equation which enters into some of the other tests."

Ballast Sections to Meet Present-Day Requirements

The committee reported progress in its study of the design of ballast sections in line with present-day requirements, and indicated that at a later date it plans to submit for consideration a ballast section for each of the various classes of tracks, employing different kinds of ballast. Before proceeding further with its study, however, it offered for approval or modification as to basic design, and not for inclusion in the Manual, a ballast section for crushed stone, which, except for depth, is a composite of standard ballast sections of the different roads represented on the committee.

In presenting this section of the report, the chairman stated that the committee had decided to offer this section for adoption and so moved, but E. M. Hastings (R.F. & P.) arose for a point of order, declaring that the committee could not ask for such a change of action without 30 days notice and his position was sustained by the president. In response to a request for comments, O. E. Selby (C.C.C. & St.L.) called attention to inconsistencies in the dimensions that in his opinion required collaboration with the Committee on Roadway, and Chairman Kennedy said that the committee would take his comments under advisement.

Other Subjects

The committee reported progress in the preparation of an outline of its complete field of work.

Report on Economics of Railway Operation

J. E. Teal, Chairman*

Following another year of activity, the committee presented detailed reports on four of its nine assignments, all having to do with factors affecting the economy and efficiency of railway operation.

In the absence of Chairman Teal the report was presented by M. F. Mannion of the Bessemer & Lake Erie.

More Intensive Use of Railway Facilities

Supplementing its report on this subject in 1935, when the committee outlined in detail the economies resulting from an actual co-ordination project, the committee this year discussed the problems and obstacles usually confronted in large and involved co-ordination studies. At the outset of its report, it listed the more important of these obstacles, which it classified in the three following groups: Selection of facilities and operating methods; economic justification of project; and property rights. Subsequently, it discussed in some detail these various classes of obstacles, and then devoted the remainder of its report to principles governing agreements. In this latter regard, it stated that it is

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* Transportation Engineer, Chesapeake & Ohio.

extremely difficult to set up principles to be observed in connection with the preparation of agreements between roads involved in co-ordination projects, but that these principles can be divided into the two following groups:

(1) Those applicable when the carrier whose facilities are retired becomes a tenant of the carrier whose facilities are retained by acquiring trackage rights.

(2) Those applicable when the carrier whose facilities are retired becomes a joint owner of the facilities retained for joint use by the purchase of an interest in such facilities.

On the basis of these two arrangements for effecting consolidation projects, the committee discussed under 17 sections the principles governing the drawing up of trackage rights agreements, and under 19 different sections, the principles to govern the preparation of joint ownership agreements.

Problems Relating to More Efficient Operation

The committee withdrew its report on this subject as presented in Bulletin 392 for further consideration.

Effect of Traffic Density Upon Operating Ratio

In its discussion of this subject, dealing specifically with the formulation of a method of determining the effect of a moderate change in traffic density upon the operating ratio of a railway, the committee first pointed out that it is a well recognized fact that, with the expenses of a railway composed partly of fixed expenses and partly of variable expenses which fluctuate with fluctuations in traffic, the normal effect of an increase in traffic density is to produce a decrease in the operating ratio, and vice versa. It then indicated how the specific effect upon the operating ratio may be calculated from applying formulas and methods set forth in previous reports to the association, but, finding this process laborious, it proceeded to outline a more simple method which produces at least approximate results. Concerning this method, the committee said, in part, as follows:

"The method proposed is based upon the previous work of the committee and may be used for moderate changes in traffic density up to 30 per cent in cases where the capacity of the railway to handle increased traffic density is not in question. The method is presented in the form of two alinement charts.

The first chart correlates the percentage change in traffic density to the percentage change in operating expenses for any increase in traffic density from 1 per cent to 30 per cent, and for all cases of initial traffic density from light to very heavy. Once the percentage increase in expenses for a given percentage change in traffic density is determined, the effect upon the operating ratio is a simple mathematical calculation."

With the presentation of the two alinement charts employed in its simplified method, the committee also presented a complete example explaining in detail the use of the charts. It also included in its report, as an addenda, a discussion of the method of constructing simple alinement charts to show the relationship between three or more variables under certain conditions.

Train Resistance as Affected by Weight of Rail

At the outset of its report, the committee stated that the resistance to train movement due to rail is, theoretically, affected by the following factors:

(a) Weight (size) of the rail;
(b) Design, as it affects stiffness;
(c) Design, as it affects head bearing surface;
(d) Placement, i.e., vertical or canted;
(e) Condition, as to worn head or battered ends;
(f) Joints, as to strength, stiffness and physical condition; and
(g) Chemical and physical characteristics as affecting distortion of the head surface under wheel loads.

In its report, the committee discussed each of these factors, referring at length to previous works bearing on the subject, including the reports of the Committee on Stresses in Railroad Track; the monograph on "Economics of Railway Track" by James M. Farrin; the study on "The Economical Selection of Rail," by A. N. Reece; and a "Study of the Effect of Various Intensities and Repetitions of Wheel Loads Upon Rails" which appeared in the association proceedings for 1926.

Summing up its findings, the committee presented the following conclusions:

"Neither train resistance nor internal stress in rail is affected by the weight of rail, except as weight is used to modify the moment of inertia (or stiffness) of the rail section.

"The effect on train resistance of the head bearing surface of a rail is negligible after the head surface is worn to fit the average worn contour of wheels.

"The quality of rail and joint maintenance as affecting train resistance may be disregarded, upon the assumption that over a period of time the average maintenance conditions would be the same for any two or more rail sections under consideration.

"The effect of weight of rail on train resistance is in turn modified by wheel loads and spacing of the wheels."

In a last conclusion, the committee, referring to a group of charts having to do with track depression under wheel loads, submitted with its report, said that the method used in preparing these charts may be considered as a guide in approaching the problem of train resistance as affected by the weights of rails.

It was recommended that the report be received as information and the subject discontinued.

Other Subjects

Other subjects considered by the committee, but on which no report was made, are as follows: Revision of the Manual; analysis to determine when a railway or branch line should be retired; methods of determining the most economical train length, considering all factors entering into transportation costs; the economic limits of the movement by the railway of freight from shipper to receiver, by rail, by highway or by a combination of both; and outline of complete field of work.

Report on Impact

O. F. Dalstrom, Chairman*

In its report for this year, which was presented as a progress report, the committee confined its attention primarily to the first of its assignments with regard to tests of short steel spans with open floor, together with effect of inequalities of track and of rough wheels on such track. In the early part of its report, the committee referred to the methods of procedure used in tests conducted by the Cleveland, Cincinnati, Chicago & St. Louis, and by the Pennsylvania, and then set forth the problems involved in making similar tests as called for in its assignments. Among these it pointed out the large cost which would be involved in purchasing suitable testing equipment and for conducting the tests, and the fact that the character of work involved does not lend itself to being divided up and assigned to sub-committees for study and report.

As no funds were made available for carrying out any of its assignments, the committee was unable to carry on field work, and, therefore, confined its activities to the investigation of equipment and methods, and to recommendations for the procedure to be followed in carrying out its assignments. In this latter regard, it recommended a five-point program necessary to the effective conduct of its work. This program includes the setting up of suitable field and office organizations, the purchase of suitable testing and recording equipment, the selection of suitable bridges to be tested, the provision of funds to carry out the work, and the assignment of jurisdiction over the work.

As regards the organization and equipment necessary to carrying out its work, the committee said, in part, as follows:

"The conduct of the tests on bridges should be placed under the immediate charge of a director of research who shall have a staff of one or two technical assistants and such mechanics and laborers as the nature of each particular assignment may require; also, an office staff whose duties it shall be to interpret the test records and to put them in usable form.

"Adequate equipment suitable for the work contemplated should be purchased, mounted and housed so that it can be moved and set up at any bridge selected for the tests. This equipment should include not only the necessary measuring and recording devices, but also telephones and necessary devices for controlling the test train movements from the central point where the testing outfit is set up."

Other Subjects

Other subjects assigned to the committee, but not reported upon except as referred to indirectly in the general discussion in its report, are as follows: (1) Tests of steel spans with ballasted decks, including spans with precast concrete decks and poured-

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in-place concrete decks; also tests on ballasted decks with timber floor; particular attention to be given to the damping due to the type of deck and the track ballast; (2) tests of dynamic shear in girder spans and truss spans; and (3) tests of impact in columns and the hangers of steel spans. The committee did, however, present as information a complete outline of its field of work.

Following the presentation of the report, President Wilson asked the committee if it was its intention to ask the Board of Direction for approval of its program and the appropriation of the necessary funds to carry it out. Chairman Dalstrom said that a complete estimate of the expenditure that will be involved to carry out its program had been made available to the Board, and that the committee was awaiting an indication of the Board's reaction to its proposed program. In the event that this reaction is favorable, he said that the committee is prepared to proceed promptly with its work.

Meyer Hirschthal (D. L. W.), referring to and in line with a resolution which had been forwarded to the committee and to the president of the association, criticized the fact that the committee had given consideration to the matter of impact only as it affects steel structures. He contended that the consideration of the committee should also include concrete and timber structures. Replying to this criticism, President Wilson said that this matter had not been overlooked by either the committee or the officers of the association, and that an attempt to arrive at some agreement in this matter would be made at an early meeting of the Committee on Outline of Work and the Special Committee on Impact.

Report on Shops and Locomotive Terminals

J. M. Metcalf, Chairman*

Although actively engaged during the year in studying all five of its subject assignments, the committee presented only two brief progress reports in addition to an outline of its complete field of study.

Adaptation of Engine Terminal Facilities for Handling Oil-Electric Locomotives and Rail Cars

Supplementing its report of last year, in which was presented a brief description of the major facilities on one road for handling stream-lined articulated trains operated by oil-electric locomotives, the committee, in this year's report, suggested that in considering the adaptation of engine terminal facilities for handling oil-electric locomotives and rail cars, attention should also be given to air conditioning, air service, water service, storehouse facilities, shop facilities and electric lighting. As regards these additional factors, it said as follows:

"Approved electric outlet boxes should be provided at suitable locations alongside the inspection pit for use in connection with air conditioning service provided to trains before being taken from the coach yard to the passenger terminal.

"High pressure air piping, with suitable outlets located alongside the pit, should be furnished for servicing and testing air brakes and for cleaning service.

"Suitable outlets should be furnished alongside the pit and storage tracks to furnish water to the service water tanks under the train and for cleaning purposes.

"Necessary stores facilities should be furnished close to the passenger yard for carrying supplies peculiar to this type of equipment.

"The necessary shop facilities for turning wheels and axles and for making other necessary repairs to this type of equipment should be located close to the passenger yard.

"Electric illumination should be provided along both sides of the pit and storage tracks for use in servicing these trains during the night."

Power Plants

The committee undertook this year to make a study of power plants at important railroad terminals, where the plants are entirely self-supporting, that is, those generating steam and electric power within their own walls for all demands. Its brief report as a result of this study was as follows:

"There are comparatively few plants of this character, and those in operation were, for the most part, constructed a number of years ago and present little information of real present value. Likewise, the demands and functions of such plants are so varied that it is almost impossible to draw general conclusions. As regards the more modern installations, this study is further complicated by the introduction of Diesel engines for generating current. This tendency is particularly prevalent in sections where petroleum fuel oil is cheap and coal is expensive."

Other Subjects

In addition to presenting an outline of its complete field of work, the committee reported progress in its study of the revision of the Manual and of welding equipment installations as applied to shops and locomotive terminals.

The report of the committee was received without discussion.

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Report of Committee on Rail

J. V. Neubert, Chairman*

Nine subjects having to do with rail and allied matters were reported upon in some detail by the committee, including the usual rail failure statistics, the advisability of rail lengths in excess of 39 ft., the continuous welding of rails, and the effect of contour of the rail head on head wear. In this latter regard, the committee recommended a modification in the top radius of the head of the 112-lb. section, adopted in 1933.

Revision of the Manual

Following a complete review of the Manual and its supplements, reported upon last year, the committee recommended only a few minor changes this year, these having to do with the stamping of ingot numbers on rails as rolled, and with the general requirements for standard rail joints. It reported that it has been studying suitable designating marks for controlled-cooled and normalized rail, but certain complications encountered made it impossible to present definite recommendations at the present time.

The recommendations of the committee were approved.

Rail Mill Practice and Manufacture

In a brief report, which the committee stated would be amplified on the floor of the convention by remarks by Prof. H. F. Moore, research professor of engineering materials, University of Illinois, the committee outlined the work of the Rail Manufacturers' Technical Committee during its sixth year of investigation, and the character of the investigation work to be carried out by the committee during the next two years. It stated that the work of the committee during the last year has concerned itself largely with four lines of study; the thermal treatment processes for preventing shatter cracks in rails; acceptance tests for rails; non-destructive tests for detecting shatter cracks; and further field tests of the effect of frequency of high wheel loads, including wheel and rolling-stock defects. In addition to the above, the committee made a beginning in the study of rail-end batter, and of the effectiveness of various end-hardening processes to minimize batter.

During the proposed two years' extension of the work of the Rail Manufacturers' Technical Committee, it is proposed to continue study of the four subjects given consideration during the last year. However, emphasis will be shifted from the study of the mechanism of shatter cracks to the study of rail-end batter, the end-hardening of rails, and the building up of rail ends by welding.

Chairman Neubert presented for information and discussion during the year a tentative specification for the controlled cooling of rails, this being an addition to the published report.

Dr. H. F. Moore, under whose direction the investigation of the cause of transverse fissures has been conducted, described the work that is now under way. During the year additional field tests have been made to determine the magnitude of wheel loads in actual practice, the maximum found having

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been 65,000 lb. and 84,000 lb. at 30 miles an hour. He said that while other factors, including the condition of the track, have considerable influence on the magnitude of wheel loads, irregularities in the contour of the wheels themselves, including flat spots, produce the highest loads.

As a result of the investigation it has been concluded that bending tests are superior to impact tests for the detection of shatter zones in rails, and that they give all the information obtained from impact tests, together with additional data.

During the coming year, study will be made of rail batter, the effect of hydrogen gas in producing shatter cracks, the effect of overstrain of rail steel and a study of the cooling of rails will be started.

Rail Failure Statistics for 1935

As in the past, the report with regard to rail failures was prepared by W. C. Barnes, engineer of tests for the committee. The statistics presented, which were as of December 31, 1935, were compiled, as formerly, in accordance with the standard method of basing the failure rates on mile-years of service in track. Statistics on the 1930 rollings of all mills, according to the report, show that for the five-year period 1931-1935, there was an average of 60 failures per 100 track-miles, which is less than one-half the number reported in 1936 for the 1929 rollings, and the smallest number within the records of the committee, which begin with the rollings of 1908. Both service and detected failures are included in these figures.

As in past years, the report also contained an analysis of rail failures with respect to the rollings of the different mills, and a number of tables, diagrams and charts showing trends in failure rates. One mill comparison table showed failures per 100 average track-miles per year, indicating separately service and service plus detected failures for each of the 1930 and subsequent rollings, while a second mill comparison table showed failures per 100 average track-miles per year, per unit of traffic density, for the same rollings.

Transverse Fissure Statistics for 1935

The report on this subject, as in past years, was prepared by W. C. Barnes, engineer of tests for the committee, and constitutes a cumulative record of transverse fissure failures that have been reported up to and including December 31, 1935. The statistics included cover all fissured rails reported, whether located by actual breakage in the track or detected before breakage by inspection or test. Some of the more important data presented, include the total fissure failures reported each year since 1919; fissure failure rates from date rolled to December 31, 1935, by mills, with service and detected failure rates separated; and transverse fissure failures reported by individual roads, likewise separated as regards service and detected failures.

According to the report, the accumulated grand total of transverse fissure failures, service and detected, up to December 31, 1935, from all rollings, as compiled from data submitted by roads which report regularly, was 91,669, which is an addition during the year 1935 of 12,364 on these same roads. Of these 12,364 failures, 7,497 were detected failures, and 4,867 were service failures. This number of failures in 1935 represents an increase of 2,544 failures over the total reported in 1934. Of the total failures in 1935, 60.6 per cent were detected before actual breakage occurred. During the period 1929 to 1935, inclusive, a total of 23,575 detected and 32,672 service failures were reported, making the detected failures average 41.9 per cent of the total fissure failures.

A.A.R. Detector Car

In a brief report on the operation of the A.A.R. detector car, Mr. Barnes reported as follows:

"As of November 26, 1936, the car had tested a grand total of 40,100 track-miles of rail. The track mileage now tested per year averages about 6,000, which is an 100 per cent increase over that tested in 1929. There has been a steady increase in the number of transverse fissures detected per mile of track tested, the number detected in 1936 being approximately 10 per cent greater than in 1934. The total failures detected have increased 100 per cent in the same period."

Cause and Prevention of Rail Batter

During the last year, the committee continued its study of the cause and prevention of rail battering and methods of reconditioning rail ends, fastenings and frogs in track, but its report was brief and had to do with the investigation being carried out at the University of Illinois, under the direction of Prof. H. F. Moore, with regard to the end-hardening of rails. The report stated that this investigation, which is being carried out under an assignment similar to that under which the study of transverse fissures and other defects of rails has been handled previously, is well under way.

Rail Lengths in Excess of 39 Ft.

Continuing its report of last year, the committee, following a brief statement of experience in the United States and foreign countries with long rails, discussed at some length those factors having to do with the practicability of producing and using rails in excess of 39 ft. long on the railroads of the United States. These factors included mill practice; transporting rail; unloading rail; laying rail; expansion requirements; the relation of rail length, expansion allowance, laying temperature range and restraining forces; design of joint bars; ballast and fastenings required; maintenance difficulties; rail failures; and rail creepage.

The lengths of rails considered in the report were 45 ft., 60 ft., 66 ft., 78 ft. and 117 ft. The major obstacle to rails of a length greater than 39 ft., appear, according to the report, to be changes required in mill practice and equipment. In this regard, the committee pointed out that in order to produce economically any standard rail length in excess of 39 ft., mill changes would be required in the hotbeds, straightening machines, drill presses, and controlled-cooling or normalizing facilities. It pointed out that a considerable investment will be required to make these changes, but stated that probably very little more investment would be required to change from 39 ft. to 117 ft., as compared with increasing the 39-ft. length to 45, 60 or 78 ft.

The committee found that no unsurmountable problems were presented by transporting, unloading or maintaining long rails, and stated that according to experience thus far, ballast and fastening requirements, rail failures, rail creepage and track buckling are not matters of primary concern.

Continuous Welding of Rail

As a result of its first year of study of this subject, the committee called attention to the fact that it proposes to determine the strength of welded joints from tests to be conducted in the laboratory on specimens of rail welded by different processes. It then outlined in detail the specific character of laboratory tests and studies to be carried out, which include essentially metallographic studies of welded joints, mechanical tests of numerous specimens cut from various parts of the weld, drop and bend tests of full-size specimens of welded rail, and rolling load tests of full-size welded rail. It pointed out that the information developed will be compared with tests of ordinary joints and full section rail made by the special committee on Stresses in Railroad Track.

Chairman Neubert announced that $10,000 has been appropriated to conduct tests on the butt welding of rails, and that these tests will be conducted at the University of Illinois.

Service Tests of Various Types of Joint Bars

The report of the committee was essentially a statement of the method of procedure which it proposes to follow in carrying out its work. It stated that it is the intention to undertake service tests of joint bars as applied to new 112-lb. RE and 131-lb. RE rail, and that arrangements for these tests have already been made with the Santa Fe and the Pennsylvania. All of the rail within the test sections will be controlled cooled, and some of the rail will be end-hardened.

Effect of Contour of the Rail Head on Wear

Study of this subject was undertaken because of the report of several roads late in 1935, that considerably more flow of metal was occurring on top of the new 112-lb. RE rail section, with its 24-in. top radius, than was the case with the previous 110-lb. RE section with its 14-in. radius.

Commenting upon the adoption of the 24-in. head top radius, the committee stated that for many years the 110-lb. RE rail section had a 14-in. top radius, with 3/8-in. radius at the corner

joining the side. When the 112-lb. RE section was adopted, the top radius was changed to 24-in., followed by a 1-in. radius and a ¼-in. radius at the corner, in an effort to widen the area of contact between rail and wheel, and to relieve pressure along the edge.

As a result of its study of the subject, based upon data accumulated from many roads, the committee presented a series of general conclusions, which are abstracted in the following:

(1) It is difficult for the mills to control accurately the specified top radius, resulting in considerable variation.

(2) A large proportion of the 112-lb. RE rail in service was rolled with a top radius of 14 in. to 16 in., instead of 24 in. as called for.

(3) Where approximately 24-in. top radius was rolled, the rail when first laid showed considerable crosswise flow of metal and corner beading due to cold rolling of the wheels. Pressure was concentrated along the edges, and a black streak down the center indicated no bearing along the central portion of the head.

(4) Following a few months' service, depending upon the density of traffic, practically all rail measured, regardless of its initial top contour, showed a radius of about 12 in.

(5) Contours taken of the treads of a considerable number of worn cast iron and steel wheels disclosed that the average contour of wheels in service have a concave tread with a radius of approximately 14 in.

(6) The concave wear of wheel treads is independent of the contour of the top of new rail, as the center of tread naturally tends to wear faster due to lateral oscillation of the wheels.

The committee called attention to the fact that in an effort to further the study of rail head flow and distortion, as affected by the top radius of the head, both the Chicago & North Western and the Burlington had installed large tonnages of 112-lb. rail in 1936, which had a 14-in. top radius and ⅜-in. corner radius. It stated that results to date have been very favorable, much less flow of metal and beading being reported than was previously the case with the 112-lb. section having a nominal top radius of 24 in.

As a result of its study and observations, the committee presented a revised section of the present 112-lb. RE section, which it recommended for eventual adoption. It pointed out that the only change involved is the substitution of a 14-in. radius for the 24-in. radius in the central portion of the top of the head, and a ⅜-in. top corner radius for the former ¼-in. radius. This change does not affect the total height of the section, the width of head, or other physical properties.

C. W. Baldridge (A. T. & S. F.) cited an investigation on the contour of the heads of 112 and 131-lb. rail in which it was found that the maximum and minimum radii for new rails were 15 and 8.5 in. respectively, instead of the 24 in. called for by the standard plan. It was also found that the corresponding radii of worn rails were 12 in. and approximately 10 in. He contended that since rails with radii of 24 in. are not being rolled, the beading complained of results from other causes, an important one being failure to adze the ties in such a way that both rails will be in the same plane.

R. T. Scholes (C. B. & Q.), chairman of the subcommittee, stated that the Burlington and the Chicago & North Western have been using the revised section proposed by the committee and that beading has been greatly reduced.

The revised section was adopted as recommended practice.

Other Subjects

In addition to the above, the committee presented an outline of the complete field of its work, and reported progress in the study of the economic value of different sizes of rail.

Rules and Organization

E. H. Barnhart, Chairman*

Collaborating with appropriate committees within the association, the committee recommended a number of changes in existing rules in the Manual, and presented a large number of additional rules for the guidance of employees in the maintenance of way department.

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Revision of the Manual

As the result of its consideration of material in the Manual, the committee recommended revisions in a considerable number of the rules governing the handling and storage of ties, lining and surfacing, frogs and switches, and the maintenance of wood bridge structures. It also recommended certain changes in rules affecting pumpers, motor car maintainers, work equipment repairmen, work equipment operators, road crossings, track tools and oil houses. Some of the revisions recommended were relatively important in character, while many of them, particularly as regards motor car maintainers and work equipment repairmen involved merely the renumbering of existing rules.

These revisions were accepted.

Protection of Treated Ties and Timber

Collaborating with the committees on Ties, Wooden Bridges and Trestles, and Wood Preservation, the committee presented for adoption three new rules (Nos. 693, 694 and 696) having to do with the storage of crossties, and six new rules (Nos. 704, 707, 708, 709, 713 and 714) having to do with methods of making tie renewals. It also presented for adoption three new rules (Nos. 1215, 1216 and 1217) with regard to the use and handling of timber, and six new rules (Nos. 1225, 1226, 1227, 1228, 1233 and 1236) with regard to the handling and use of piling.

These rules were adopted with minor changes.

Rules for Fire Protection

Last year, as a result of co-operation with the Committee on Water Service, Fire Protection and Sanitation, the committee presented as information specific rules covering the duties of the following maintenance of way employees in preventing fires: Section foreman, watchmen, bridge and building foremen, painter foremen and water service repairmen or gang foremen. In addition to these specific rules pertaining to these particular employees, the committee also presented at that time a set of 27 rules on conduct of work, which apply to these employees as a group. In its present report, without comment, the committee resubmitted all of these rules, with the recommendation that they be approved for publication in the Manual.

These rules were adopted.

Outline of Work

In handling its assignment to prepare an outline of its complete field of work, the committee not only presented an outline, but also a tabulation of all of the rules for the guidance of employees in the maintenance of way department, appearing in the 1929 Manual and supplements thereto. These rules were listed under the heads general, duties of division officers, conduct of work, miscellaneous and organization.

Signals and Interlocking

C. H. Tillett, Chairman*

Continuing its practice of recent years, the committee presented its report under the two main heads—Developments in Railway Signaling, and Principle Current Activities of the Signal Section, A.A.R. Under developments in railway signaling, the committee discussed roller bearings for switches, dragging equipment detectors, increased efficiency secured in railway operation by signal indications in lieu of train orders and timetable superiorities, and automatic train control and cab signals.

Roller Bearings for Switches

After pointing out the increased difficulty and increased power requirements in operating the longer and heavier switches in use today, including those up to 45 ft. in length and involving 131-lb. and 152-lb. rail, the committee described briefly a roller bearing device to minimize friction in the movement of switch points, which it stated that road tests had showed requires approximately 60 per cent less power for the operation of switches so equipped than of switches not so equipped. The device provides for the support of practically the entire weight of the switch

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rail on roller bearings, while the switch rail is in transit. However, when a train travels over a switch equipped with the device, the switch point is supported by the tie plates in the usual manner. The committee reported that this device has been in road service for more than a year, during which period it has given satisfaction on both manual and power-operated switches, and said that it is especially advantageous when used in connection with centralized traffic control installations and on remote-control and spring switches.

Dragging Equipment Detectors

The report of the committee included a description of one of the one or more devices developed recently to detect dragging equipment on trains. It pointed out the most common causes of dragging equipment as broken arch bars and broken brake rigging, and then explained how these failures may cause derailments at switches and interlockings, with serious damage to trains, tracks and interlocking equipment.

The device described consists of cast iron loops which are located on both sides of each rail just below the top, in the path of broken arch bars and other dragging equipment. The cast iron loops are attached to posts placed about three feet in the ballast, and are connected with wayside signal circuits, and with cab signal circuits in cab signal territory, in such a manner that when broken by dragging equipment, the wayside signals and the cab signals change so as to show the engineman that he must stop as soon as possible, consistent with safety, and have his train inspected.

Signal Indications in Lieu of Train Orders

In its report on this subject, the fourth made since 1929, the committee discussed the increased efficiency secured in railway operation by signal indications in lieu of train orders and time-table superiorities, and brought up to date the signal installation figures included in its last report, made in March, 1933. The present report shows that as of December 31, 1935, train operation by signal indications was in effect at 939 installations on 73 roads, involving a total of 14,937 miles of road and 31,200 miles of tracks. In bringing the previous mileage data up to date, the committee found that a considerable mileage of block signal operation should be included, such as one-direction and either-direction operation by signal indication in manual block, controlled-manual-block and automatic block territory.

In recent years, according to the report, with the advent of improved signaling devices, the use of train orders has been greatly reduced for normal train movements. Trains are directed by block signals operated manually, or by interlocking, remote control, centralized traffic control, controlled manual block and automatic block signals, all by signal indication, without train orders, except in emergency, for slow orders and the like. With the increased speed of both freight and passenger trains, it has been necessary to direct trains by signal indications, diverting them from one track to another without delays by means of interlocking facilities. The report as a whole brings out the wide application of this improved method of directing train movements, which not only provides increased speed of operation, but increased safety and economy of operation as well.

Automatic Train Control and Cab Signals

As of July 1, 1936, the report showed that there were 8,193.7 miles of road and 15,154.7 miles of track in the country (including 229.0 miles of road and 481.3 miles of track in Canada) equipped with automatic train control; 2,283.3 miles of road and 5,073.5 miles of tracks in the United States equipped with automatic cab signals; and 3,849.9 miles of road and 7,789.6 miles of tracks equipped with automatic cab signals and with either or both automatic train control and automatic wayside signals.

Following a tabular summary in the above respect, the report included a table showing the number of locomotives equipped for interchangeable operation over different types of automatic train control and cab signal track installations, and a considerable number of items of interest concerning the status of various types of installations on different roads, experiments being conducted, and orders or actions of the Interstate Commerce Commission, the Bureau of Safety, etc.

Current Activities of the Signal Section, A.A.R.

In this part of its report, the committee included a synopsis of the principal activities of the Signal section since November, 1935, reported at the 1936 annual meeting of the section. In addition, it listed the specifications, drawings, requisites, instructions and miscellaneous matters revised; the new specifications, drawings, instructions and miscellaneous matters prepared or handled; and the specifications and miscellaneous matters which it recommended be removed from the Manual.

The report of the committee as a whole, which was presented as information, was received without discussion.

Economics of Railway Labor

F. S. Schwinn, Chairman*

The committee presented detailed reports on five subjects having to do with factors affecting maintenance of way practices and the amount of labor employed, and reported progress in the study of five other related assignments.

Roads That Have Greatly Reduced Labor Requirements

The report on this subject had to do exclusively with an analysis of maintenance of way operations on the Norfolk & Western since 1923, this report following and being in line with a more or less similar analysis of maintenance of way operations on the Lehigh Valley, submitted to the association in 1934.

In a general discussion of the maintenance of way policy which has been followed by the Norfolk & Western since 1923, the committee pointed out that this road has recognized the economy resulting from improvements made in its roadbed and track structure, and has consistently followed the policy of investing a liberal share of its earnings in such improvements. It then pointed out how, after the period of federal control in 1920, this policy called for expenditures for maintenance of way and structures which increased to a maximum of $16,413,152 in 1926. These expenditures made possible a reduction of maintenance of way and structures expenses in the succeeding years, these expenses having fallen to $14,838,067 in 1929, although revenues in that year were almost as large as in 1926.

In its analysis of maintenance of way operations on the Norfolk & Western, the committee presented a table showing the total man-hours expended in maintenance of way and structures work during the years 1923 to 1935, inclusive, together with other pertinent information. It also presented 10 charts showing, for the years 1923 to 1935, inclusive, the added capital investments for grading and ballast, rail and other track material, and roadway accounts; total man-hours of labor and man-hours per mile of track maintained; total man-hours of section foremen and signalmen; expenditures for track laying, surfacing and roadway maintenance; cost per track mile for track items; and maintenance of way and structures expenses, operating revenue and maintenance of way ratio.

Commenting upon the performance of the Norfolk & Western, the committee said, in part, as follows:

"The outstanding value of this study on the Norfolk & Western is to emphasize the fact that its policy of betterment not only made possible a reduction of man-hours employed in maintenance work prior to the beginning of the depression, but also permitted a reduction in maintenance labor during the lean years of the depression that was proportionately greater than the reduction in revenues, and that this was accomplished without any lowering of its standards of maintenance. Undoubtedly the decrease in tie renewals through the use of treated and well-plated ties has been a major factor in the performance of this road, while heavy rail, deep ballast and thorough drainage have also had an appreciable effect."

Organization of Forces for Maintenance Work

The report of the committee this year had to do entirely with tie renewal gangs and rail renewal organizations. In its discussion of tie renewal gangs, the committee presented the organization which one road employs for making annual tie renewal over its system independent of surfacing operations, and the organization of 75- and 90-man gangs which another road employs to make periodic renewal of ties at intervals of three to five years in connection with surfacing operations. As a result of its study

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of these organizations, the committee arrived at the following conclusions:

"Economy in the work of renewing ties results from the practice of having men perform the same duties each day.

"Where such forces are trained to produce a fair average output of work of standard quality, tie renewals are more uniform, accidents are reduced, and more efficient work is accomplished in a shorter time than results from the use of section or other similar forces.

"The use of such specialized gangs permits the section forces to spend their time on other essential work."

In its discussion of rail renewal gangs, the committee, carrying forward its reports on this subject in 1929 and in 1933, presented a detailed description of the organization and equipment used on one road in the laying of 126.5 miles of new rail in a period of 42 working days. In this work, where 112-lb. rail replaced 85-lb. and 100-lb. rail, a special rail laying organization, fully mechanized, was employed.

At the end of its report, the committee offered the following comment as its conclusion:

"Upon comparing rail laying organizations now generally adopted with those in use several years ago, we feel that it is important that rail renewal organizations be modified from time to time to permit the utilization of the most recent developments in mechanical equipment."

Economies in Labor Through Increased Capital Expenditures

In a general discussion of the possible economies in labor to be effected through increased capital expenditures, the committee first discussed the adequacy of the railways to meet present and future traffic requirements. In this connection, it expressed the opinion that, with further increased efficiency, the railways will be capable of handling a volume of business much greater than has come to them during the depression years, without an appreciable increase in capital expenditures. However, it stated that the roads are now looking about for a place to spend money to save money. With labor the largest item in railroad maintenance, it said that it is only natural that the railways are looking for opportunities for spending money to effect sizable reductions in labor costs.

With approximately one-quarter of the labor employed by the maintenance of way and structures department entering into track maintenance, the committee first concentrated its study on the effect of increased capital expenditures on track labor. However, it pointed out that in later reports it will give consideration to the effect of such expenditures on bridge, building, water service, signal and other maintenance of way labor.

As regards capital expenditures by the railways at the present time, the committee stated that the present financial condition of the railways is such that only those moderate expenditures are justified as are productive of comparatively large and immediate savings. In this classification, it mentioned expenditures for stabilization of the roadbed as the class which will bring about the greatest and quickest returns. In this regard, it said that capital expenditures for subsoil drainage in cuts and the drainage of water from pockets beneath the track will save track labor as well as ballast, ties, joint bars and rail ends. Continuing, it pointed out that the roadbed is further stabilized by an ample depth of ballast, by wide cuts with open ditches, and by ample width of fills.

In the remainder of its report, the committee discussed in a general way the economies in labor possible through expenditures for the best grade of ballast, treated ties and ties of increased length, heavier rail sections and improved track fastenings, and labor saving equipment and devices. In conclusion, it stressed the importance of this subject to the railways and called for the most sincere co-operation on the part of members of the association to the end that it might develop material and facts of the greatest benefit.

Rail-End Welding and Use of Reformed Bars

The committee reported that it had collected a large amount of information with regard to the cost of building up rail ends, organizations for welding gangs, the cost of reforming and applying joint bars, and the cost of applying joint shims, but found that only 1 of 24 roads reporting seemed to have kept records in a form from which can be determined the difference in cost (either man-hours or money) of maintaining joints before and after building up or using reformed bars. On this road, a large, heavy-traffic terminal division indicated a man-hour saving of 74 per cent, while a high-speed, heavy-traffic division reported a saving of 78 per cent, and another division, a saving of 50 per cent. Only two of the roads reporting estimated that no economy would accrue through improvements in rail joint conditions. All of the other roads expressed the opinion, or belief, that a decided saving in track labor is effected in the maintenance of joints built up by welding or improved through the use of reformed bars. These roads also indicated an extension of the life of the rail, joint bars, and joint and shoulder ties, and largely improved riding conditions. Estimates of the savings, made by division engineers and roadmasters, ranged all of the way from 20 per cent to as much as 95 per cent.

In conclusion, the committee said, in part, as follows:

"It is believed that a fairly accurate estimate of savings can be obtained from division engineers, roadmasters, track supervisors and section foremen. They know that it is almost impossible to maintain proper surface when rail ends are battered, and that after the rail ends are made smooth by building up, or by using rail shims or reformed bars, the joints hold up much better and require much less labor for surfacing."

Having on hand a very limited number of estimates, and fewer authentic figures from records of actual performance, the committee stated that it was not yet in a position to determine the specific economy in track labor to be effected through the maintenance of joints by welding and the use of reformed bars.

The Effect of Higher Speeds on Labor Costs

In a comprehensive report, which it was recommended by considered as complete for the present time, the committee first discussed in some detail the important developments which have taken place in locomotive and car design during the last five years, and also the trend toward higher speeds of both passenger and freight trains. As regards increased speeds, the committee stated that existing passenger schedules have been shortened variously up to 25 per cent, while the newer trains are being operated on schedules that are as much as 30 to 40 per cent shorter than those of the previously fastest trains. Likewise, it continued, freight service has been speeded up almost universally, and not a few of these trains are now running at speeds from 50 to 100 per cent faster than formerly.

In the body of its report, the committee discussed the greater refinements in track required for high-speed service, the effect of high speed on the track, and the factors under high-speed operation which tend either to increase or decrease labor requirements. It found that there are many factors which tend either to increase or to decrease the labor requirements under high-speed operation, and that these factors are not uniform as between roads or on individual roads. For this reason, it was unable to present a single conclusion as to the effect of higher speeds on the labor cost of track maintenance which can be applied to all roads alike. In lieu thereof, it presented the following summary of its study:

"(1) Developments in the new field of higher speeds are making necessary higher standards and greater refinement in track maintenance, including greater uniformity in curve elevation.

"(2) An initial expenditure, varying in magnitude for individual roads, may be necessary to attain the higher standards demanded.

"(3) Diesel power units, steam locomotives designed for high speed, which have proper load distribution and counterbalancing, and light-weight passenger cars, when operated at high speeds, are no more destructive to track than the usual type of passenger locomotives and cars when operated at ordinary speeds. However, ordinary passenger locomotives and cars are more destructive when operated at high speeds than when operated at ordinary speeds.

"(4) At speeds higher than those for which they were designed, freight locomotives are highly destructive to track, while loaded freight cars moving on fast schedules also create considerable damage.

"(5) Higher standards and greater refinements in maintenance increase the labor cost of track maintenance, possibly as much as 10 per cent. No further increase is required where light-weight equipment and specially designed locomotives are operated,

but labor costs may be increased somewhat more than this amount where standard equipment is operated at high speed. Because of the greater damage created by freight equipment, labor costs for track maintenance may be increased by as much as 25 to 50 per cent, depending on the number of such trains, the speeds at which they are operated and the design of the locomotives."

Other Subjects

The committee presented an outline of its field of work, which it recommended for inclusion in the Manual, and reported progress in the study of the following subjects: Revision of the Manual; economies of different methods of weed killing; out-of-face renewal of track; effects of recent developments in maintenance of way practices on gang organizations; and comparative costs of maintaining track on various kinds of ballast.

The report was accepted without discussion.

Records and Accounts

C. C. Haire, Chairman*

The committee, handling subjects having to do with the proper preparation and maintenance of records and accounts, presented its report in six sub-divisions: Miscellaneous; general railway engineering reports and records; maintenance of way reports and records; construction reports and records; property records and reports; and accounting practices affecting railway engineering.

Revision of the Manual

The principal function of the committee during the year was collaborating in the revision of the new loose-leaf Manual, and the study of certain specific material in the Manual which appears to require changes to meet modern conditions. However, in addition, the committee undertook the revision of the track construction progress profile that first appeared in the Manual some years ago, and, as a result, presented as Exhibit 1 in its report a revised profile, which it recommended for adoption. This profile was adopted.

Office and Drafting Room Practices

Continuing its work of past years, in co-operation with committees of the American Standards Association, in its program of assembling a complete set of standards covering graphic symbols and drawing and drafting room practices, the committee this year presented eight new plates. These plates, which were offered as information, were as follows: Nos. 13, 14 and 15—Drawing nomenclature; No. 19—Abbreviations (materials and states); No. 20—Methods of designating (taper, batter, cant, slope, incline and grade); No. 21—Welding symbols; No. 22—Conventional welding symbols for butt welds; No. 23—Conventional welding symbols for fillet welds.

As a result of its review of plates prepared and presented to the association as information in recent years, the committee this year offered for approval and publication in the Manual the following plates: Nos. 1 and 2—Sizes of sheets for engineering drawings, forms and charts; Nos. 3, 4 and 5—Arrangement of views; Nos. 6 and 7—Sectional views; No. 8—Typical titles; No. 9—Lettering; No. 10—Mapping (modern Roman style lettering); No. 11—Lines and line work; No. 12—Standard office practice (revised); Nos. 16 and 17—Abbreviations; and No. 18—Materials, gages, bolts, nuts and rivets.

All of the plates recommended for adoption were approved.

Maintenance of Way Accounts and Requirements

Last year, the committee presented as a guide a chart showing an accounting and statistical report procedure for the maintenance of way department, set up to conform to either a divisional or centralized accounting system, and also three new forms having relation thereto. Continuing its work along this same line, the committee this year presented three additional forms (Exhibits 1, 2 and 3) with brief explanatory comments. The three new forms, which were presented as information, are as follows: Exhibit 1—Commencement and completion notice; Exhibit 2—Report of property actually retired; and Exhibit 3—Sidetracks laid, extended or otherwise acquired.

Construction Reports and Records

Continuing its study of this subject, started last year when a tentative report was made covering sidetrack, bridge and building records, the committee this year reported further in connection with bridge records, and then recommended for inclusion in the Manual a number of reports and records which were submitted as information in 1928.

As regards bridge records, it gave primary consideration this year to the numbering of bridges, and, as a result of its investigation, recommended that the mile and decimal system, with a prefix for branch lines and a suffix for overhead structures, be used in numbering all bridges, trestles and culverts, regardless of size and whether over or under the track.

Among the various records which it has prepared and submitted to the association as information in the past, the committee recommended that the following records, which it reproduced as exhibits, be approved for inclusion in the Manual: Exhibit 5—Report of quantities in completed work; Exhibit 7—Cost of property retired; Exhibit 15—Roadway machines; Exhibit 24—Construction report of timber trestles; Exhibit 25—Construction report of wood boxes and pipe culverts; Exhibit 26—Construction report of concrete arches and boxes; Exhibit 27—Construction report of steel bridges; Exhibit 28—Report of rail change; Exhibit 30—Record of rail in track by miles; and Exhibit 31—Record of heat numbers of rails in track.

All of the forms recommended for adoption were approved with the exception of those presented as Exhibits 30 and 31, relating to record of rail in track by miles, and record of heat numbers of rails in track. These two forms were held up in order that they might be considered by the Committee on Rail before final adoption.

In addition to reproducing these record forms, all of which were submitted originally to the association in 1928, the committee also reproduced as a part of its report the original text presented in 1928, explaining the reports and their use.

In addition to its study of specific record forms, the committee also made a study of its complete field of work, and announced that it proposes to develop a complete schedule of the basic reports and records that should be maintained by a well-organized engineering department.

Forms for Keeping Property Records Up to Date

The committee stated that in accordance with the plan outlined in its report of last year it had continued co-operation with the valuation staff of the Finance, Accounting, Taxation and Valuation department of the Association of American Railroads, giving consideration again to the simplification of valuation work. The results of this co-operative effort were reported in a circular issued by E. H. Bunnell, vice-president of the A.A.R., under date of December 10, 1936, and sent to members of that association. Since this circular covered completely the activities of the committee during the year, it presented the circular as its report, designating it Exhibit 1.

The circular, prefixed by a letter of transmittal, was divided into two parts. Part I dealt with the status of valuation; the work of the Accounting, Engineering and Land sections of the Bureau of Valuation; valuations issued by the Commission during the last year; valuation reports made in reorganization cases; underlying valuation figures sent to individual railroads; railroad construction indices; activities of joint committees; uses made by the Commission of valuation data; and valuation issues in court decisions. Part II of the circular had to do with simplified practices in valuation matters, particularly with regard to Account 26—Telegraph and telephone lines; Accounts 51 to 58, inclusive, Equipment; and modification of valuation orders 14 and 19.

Accounting and Depreciation

The committee first commented upon the situation as regards rolling equipment, but has been particularly interested in the problems involved in the establishment of depreciation accounting for fixed physical property. As regards the latter, it pointed out that the institution of such accounting has been postponed by the Interstate Commerce Commission. In view of this suspension of interest as regards fixed physical property, the committee recommended that this subject be dropped until such time as there

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is evidence of prospective reconsideration of the subject by the I.C.C.

Co-ordinating Work Under Requirements of I.C.C.

In handling this subject, the committee has been seeking the co-operation and help of other committees of the association and of the Department of Finance, Accounting, Valuation and Taxation of the A.A.R., in an effort to avoid duplication of effect and to simplify and co-ordinate the work being done under the requirements of the Interstate Commerce Commission. In its report, the committee stated that no specific items with respect to simplification or the avoidance of duplication have been decided upon during the year, but that arrangements have been made whereby matters originating either with the A.A.R. or within itself, may be considered by both parties. It felt that this arrangement of co-operation should be effective in avoiding duplication of effort and in bringing about the most effective methods for meeting the requirements of the Commission.

Bibliography

Continuing its practice of previous years, the committee presented a bibliographical review of books, articles, pamphlets, reports, regulatory orders and court decisions, appearing from November, 1935, to October, 1936, inclusive, dealing with subjects in which it is interested.

I. C. C. Classification of Accounts

The committee submitted no formal report on this subject, but in referring to the subject, it called attention to several rulings of the Bureau of Accounts which have a decided effect upon the maintenance of property records. These rulings are known as Cases A-94, A-109, A-110 and A-111. It submitted as information a brief synopsis of the requirements and purposes of these cases.

Report on Buildings

O. G. Wilbur, Chairman*

Of the 12 assignments of the committee, 8 were reported on in detail, while progress was reported on the remaining 4. Features of the report were the number of additions to and changes recommended in the Manual, and the final reports submitted with regard to four subjects having to do with the influence of the design of buildings on fire insurance rates; different types of paint and their economical selection; small cold storage plants for railway use; and stockpens.

Specifications for Railway Buildings

Under this assignment the committee submitted for adoption and inclusion in the Manual, two specifications submitted previously to the association, and revised in accordance with comments and criticisms received. One of these is designated "Section 30-G—Reinforced Brick Masonry Chimney," presented to the association originally in March, 1935. The other specification is designated "Section 26-C—Cement Grouted Macadam Platforms, Floors, Pavements and Pavement Bases," and was submitted originally to the association last March.

Revision of the Manual

As a result of further consideration of existing material in the 1929 Manual with regard to railway buildings, the committee recommended a number of minor revisions under those sections having to do with freighthouses and roofings, and several minor changes in different sections of the specifications for railway buildings. In regard to freighthouses, page 268 in the Manual, changes were recommended under the headings, materials and fire walls. The changes with regard to roofings had to do with that section under built-up roofs, the revised material discussing separately pitch and felt roofs, asphalt and rag felt roofs, and asphalt and asbestos felt roofs.

Under specifications for railway buildings, changes were recommended under Section 2, Excavation, Filling and Backfilling; Section 11, Sheet Metal Work; Section 12-B, Ornamental and Miscellaneous Metal Work; Section 13, Carpentry and Mill Work; and Section 14, Lathing and Plastering.

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Influence of Design on Fire Insurance Rates

In a report submitted as information, with the recommendation that study of the subject be discontinued, the committee discussed in some detail standards and rate schedules and the general factors having influence on insurance rates; the importance of giving consideration to external fire hazards; rates on contents and the effect of hazardous contents; and the desirability of giving consideration to the importance and permanence of buildings in deciding upon the type of construction to be employed. After pointing out that each building presents a special problem in itself, and that consideration should be given to fire-resistive features in old as well as new buildings, the committee presented the following conclusions:

"(1) Details of design or the class of materials used in building construction have a large effect upon fire insurance rates, on both the buildings themselves and on their contents.

"(2) The saving through reduction in fire insurance rates may not, in itself, justify the increased initial cost to bring it about. However, the added cost for fire-resistive construction is often justified far beyond any saving which may result from insurance considerations alone.

"(3) In determining the degree of fire-resistive construction to be employed in buildings, each building should be studied carefully, giving consideration not alone to the insurance rate on the building itself, but also to the importance of the building as a continuous operating or revenue-producing unit, its contemplated service life, and the effect upon the insurance rate placed upon its contents.

"(4) Where circumstances prevent the incorporation of fire-resistive construction to the extent warranted by the conditions involved, care should be exercised to meet the most important and immediate hazards, and, wherever possible, to allow in the original design for the subsequent addition of further safeguards as conditions may warrant or make possible.

"(5) Plans for railway buildings and for their location should have the benefit of the criticism of the insurance and fire prevention departments of a railway before they are finally approved."

Value of Structures Collectible in Case of Fire

A report on this subject, together with recommended conclusions in some detail, was submitted to the association as information at its 1936 convention, and suggestions and criticisms were invited. Since no changes were suggested during the year, the committee in its present report, without again publishing the conclusions presented last year, recommended that these conclusions be included in the Manual, and that the subject is discontinued.

Paints and Their Economical Selection

The committee first pointed out certain factors which make the results of most paint exposure tests in the past practically worthless for general comparative use in determining the quality of paints, and then stated that uniform terminology and methods of rating are first requisites to the assembly of worthwhile information. In line with this thought, it then presented definitions of those factors having to do with rating paint and paint performance, including color, gloss, chalking, checking, cracking, flaking, scaling, blistering and peeling.

After then discussing the importance of a standard scale for comparing paints, it explained how inspection should be made with regard to each of the factors mentioned above, and presented a report form, which it suggested as a convenient means for the accumulation of data secured from exposure tests.

At the end of its report, the committee offered the following conclusions and recommendations:

"(1) There are insufficient data available to allow definite conclusions as to the economical selection of different types of paints.

"(2) Since the railways are large users of paint, standard exposure tests should be made and the results recorded to accumulate sufficient information for definite conclusions.

"(3) For uniformity, it is recommended that exposure tests be made at an angle of 45 deg. and with a southern exposure."

Small Cold Storage Plants for Railway Use

In a final report, presented as information with the recommendation that further study of the subject be discontinued, the committee first presented a general description of those types of cold storage plants or rooms under consideration, and then discussed in order, location, operation and use, design and construction, insulation, partitions, and refrigeration and equipment.

Under insulation, it was pointed out that heavy insulation is not necessary for the storage of fruit and vegetables, but that provision is required for uniform temperatures, above freezing, for both summer and winter, and that where bananas are held for ripening, provision is necessary for humidifying and heating. In this regard it also stated that the control of humidity is necessary for general storage since some goods require a higher humidity than others, and that a working knowledge of these differences is essential to the successful operation of a cold storage plant.

In discussing refrigeration and refrigerating equipment, the committee said, in part, as follows:

"The control of temperatures is difficult where ice is used. Mechanical refrigeration with automatic control provides uniform temperatures. Cold air is generally supplied by small blower units or diffusers, or by brine pipes where low temperatures are required.

"Special consideration should be given to condensation. Where pipes are used, they should preferably be suspended from ceilings and provided with drip pans, except in rooms where condensation is not objectionable."

Stockpen Construction

In a final report on this subject, the committee presented a thorough discussion of stockpens, taking into consideration all sizes of pens from the small pen and loading chute at obscure sidings where only an occasional car is loaded, to the large collective, holding and feeding yards, where trainloads are handled frequently. The report discussed location; layout; construction, including fences, gates, loading chutes, chute gates, loading platforms and floors; water supply; feed yards; sheds; scales; lighting; and painting.

Other Subjects

The committee presented an outline of its complete field of work, and, without making report, indicated progress in the study of the following subjects: Air conditioning of buildings used by passengers and employees, and for the storage and treatment of fruit and produce; type of foundation best suited for railway buildings; improved wearing surface for platforms for heavy pedestrian traffic and for heavy freight trucking; and the design of railway buildings to withstand earthquake shocks.

This report was accepted without discussion.

Report on Masonry

Meyer Hirschthal, Chairman*

Following a year of much activity, the committee presented reports on eight of its assignments, recommending several important changes in and additions to the Manual, and reported progress in the study of seven other assignments. A feature of its report was the presentation for adoption of new specifications for rigid-frame concrete bridges.

Revision of the Manual

The more important recommendations of the committee for changes in Manual material were as follows: The adoption of specifications for high-early-strength portland cement to conform to A.S.T.M. serial designation C74-36; the revision of the present portland cement specifications by the deletion of material beginning with Article 17 after these specifications, to the end, and the replacement of this material by A.S.T.M. serial designation C77-32, standard methods of sampling and tests. Several other changes of minor character were also recommended, as well as a new paragraph covering footings at different levels, which it was recommended be added to the present specifications for foundations.

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Design of Plain and Reinforced Concrete

A feature of this report was the presentation by the committee for adoption and inclusion of the Manual, of specifications for the design and construction of rigid-frame concrete bridges. The term rigid-frame bridge, as covered by the specifications, means a bridge in which the deck is structurally integral with approximately vertical abutments. It may be built either as a slab bridge or as a ribbed bridge, and may have either curved or flat soffits. In the slab bridge, the deck structure is solid. In the ribbed bridge, the deck structure consists of ribs or girders supporting a deck slab. The soffit of the ribs may be reinforced near the abutments by a transverse slab.

The new specifications covered loads and deformations to be considered in design, preliminary design, assumptions in design, critical combinations of loads and distortions, methods of analysis, formulas for analysis, effect of loads on and distortions of symmetrical structures, effect of loads on and distortions of unsymmetrical structures, unit stresses, transverse distributing bars, radius of bend at knee, wingwalls, articulations at footings, footings, construction and expansion joints, drainage, waterproofing, longitudinal expansion joints, construction, centering, concreting methods, and curbs, parapets and handrails.

These specifications were adopted.

Giving consideration to unit stresses for buildings when wind loads are included, the committee submitted the following paragraph for inclusion in the design section of the standard concrete specifications and recommended its adoption for printing in the Manual:

"In the design of buildings when wind stresses are considered in combination with dead load and live load stresses, design unit stresses for concrete and for steel reinforcement may be increased by 33⅓ per cent, provided, however, that normal design unit stresses shall not be exceeded for the combination of dead load and live load stresses only."

This paragraph was adopted.

Continuing its work on other subjects related to the principles of design of masonry structures, the committee reported progress in the handling of its specifications for composite columns and pipe columns, submitted as information last year, and in the study of reinforced brickwork, solid concrete bridge deck slab construction of the non-ballast type, and Isteg reinforcing steel.

Vibratory Placement of Concrete

In its report on this subject, the committee first presented a general discussion of the purpose, advantages, methods and possible disadvantages of vibrating concrete, and then presented a number of the conclusions arrived at as a result of the research on the frequency of vibration in making concrete beams, conducted by Prof. M. O. Withey, of the University of Wisconsin.

As a result of its study of this subject, the committee presented the following rules pertaining to the use of vibrators, which it pointed out have been found to be helpful guides in the inspection and planning of construction operations where vibrators are used:

"Vibration is concerned primarily with plasticising and compacting of concrete dryer than can be worked properly and economically by hand. It should not be used primarily to cause concrete to flow horizontally.

"Successive insertions of internal vibrators should be made so that the visible effects of vibration overlap, that is, the areas of impulses from the vibrators should overlap.

"Internal vibrators should be withdrawn slowly, especially when used with the drier mixes.

"The minimum period of internal vibration at one location may be assumed as 15 seconds per square foot of top surface layer, computed on the basis of the radius of the overlapping impulses. A longer period may be required.

"Dry consistencies will require more vibration than the wetter consistencies.

"External vibrators should preferably be of high frequency and low kinetic energy of impulse."

Specifications for Foundations

Under this assignment, the committee presented for adoption and inclusion in the Manual, new general specifications cover-

ing the method of making and the interpretation of soil tests for railway structures. These specifications are set up in the following sections: Scope, definition, general, elastic soils, granular soils, supporting soils, and determination of relative bearing power.

B. R. Leffler, New York Central, cited personal observations which led him to question the validity of the new science of soil mechanics. This position was contested by Chairman Hirschthal, Professor Herbert Ensz of Armour Institute, and Theodore Doll. After G. S. Fanning, Erie, called attention to the fact that the same subject is under consideration by the Committee on Roadway it was voted to refer the subject back to the committee for collaboration with the roadway committee.

Pumping Concrete

This year the committee, studying the placing of concrete by pumping, drew up and presented as information a new set of specifications for pumping concrete. These specifications, including sections on scope, limitations, mixing and proportions, operation, and duplicate equipment, cover the general requirements for transporting and placing concrete by pumping, both mechanically and by the use of compressed air. As regards the limitations in pumping concrete, the specifications set forth that the maximum distance of delivery of concrete by pumping should be 1,000 ft. horizontally and 100 ft. vertically, unless otherwise permitted by the engineer in charge of the work.

Reinforced Concrete Culvert Pipe

The committee reviewed during the year the A.S.T.M. specification C76-35T for reinforced concrete culvert pipe, and, as a result, recommended that this specification be endorsed by the association. The committee found that there is a real need for specifications for the design of reinforced concrete culvert pipe, for use in checking designs presented to the railways by municipalities desiring to lay pipe lines under tracks, and also for use by those roads desiring to manufacture their own pipe. It also pointed out that the proper laying of pipe is of equal or more importance than proper design and manufacture. With these thoughts in mind, the committee stated that it proposes to prepare during the coming year its own specifications for the design of reinforced concrete culvert pipe, and specifications for laying such pipe.

Specifications for Overhead Highway Bridges

The committee attempted to review the specifications of the American Association of State Highway Officials for overhead highway bridges, with the idea of ascertaining any objectionable features, and found that in recent revisions of these specifications, many objectionable features had been eliminated. It stated that it is very much in favor of the principle of a uniform specification for overhead highway bridges that will be used by all states, and recommended that it be given representation on any joint committee that may be appointed to give further consideration to the specifications of the state highway officials.

President Wilson assured the committee that suitable action will be taken when the occasion arises.

Rating Existing Reinforced Concrete Structures

In this report, the committee pointed out that the most important items involved in the rating of existing structures are: (1) The actual condition of the different parts of the structure; (2) the effect of age and repeated loading upon the factors which enter into the computation of allowed loads; (3) the relation of the original design stresses to the actual unit stresses under live load in existing structures, and to their ultimate strength; and (4) the probable dynamic effect of the live load.

It found no obstacle to determining the actual condition of the different parts of a structure through field inspection, and plans to formulate rules and information to be applied in making such inspections. However, it pointed out that properly planned and conducted tests of existing structures are needed to obtain information on items two, three and four, mentioned above, as well as an investigation of the other actual unit stresses in existing structures, in order that the allowed unit stresses and also the proper method of analysis may be determined. In this connection, the committee recommended that funds be made available for such tests and investigations, and that the railways be requested to inform the committee of any structures that may be made available for such tests, especially structures that may be tested to destruction. Because of the complete lack of experimental data on the dynamic effect of railway live loads on concrete structures, the committee also recommended that an investigation in this direction be included in the subjects of the Special Committee on Impact, and that funds be made available in the near future for carrying out the investigation.

Other Subjects

Without making a report, the committee stated that it had made progress in advancing the following assignments: Contact with Joint Committee on Standard Specifications for Concrete and Reinforced Concrete; methods and practices in lining and relining tunnels; effect of traffic vibration on "Shotcrete" and concrete during and immediately after placing; "Presdwood," plywood, and special fibrous materials for forms and form lining; economics of light-weight aggregate; normal portland cement compared with high-early-strength cement; and outline of complete field of work.

Wood Preservation

C. F. Ford, Chairman *

In its report, which covered five subjects, the committee brought up to date the records of tie and piling tests on which it has been reporting yearly, and also gave consideration to several other subjects related to wood preservation.

Service Test Records of Treated Ties

Continuing its practice of other years, the committee included in its report the usual table of tie renewals per mile maintained on various roads, revised to include the renewals made in 1935. It also presented a series of reports on special tie tests made over a period of years on the Atchison, Topeka & Santa Fe; the Baltimore & Ohio; the Chicago, Burlington & Quincy; the Chicago, Milwaukee, St. Paul & Pacific; the Chicago, Rock Island & Pacific; the Northern Pacific; and the Union Pacific.

Piling Used for Marine Construction

Following its practice in past years, the committee reported on the present condition of the long-time test pieces and other tests prepared and observed by itself, the Chemical Warfare Service, the Sea Action Committee of the Institute of Civil Engineers—England, and other collaborators. It also reported again this year upon the status of the marine borer attack along the New England coast that is being studied by the New England Committee on Marine Piling Investigation, and upon certain other marine borer examinations conducted on the West coast. Summarizing its detailed comments on the New England marine piling investigation, the committee said, as follows:

"It can be stated that along the entire New England coast, the rate of destruction due to limnoria has, on the average, shown a marked increase. Chelura attack may be said to have remained approximately the same in 1936 as in 1935. Teredo navalis has shown a decided decrease in numbers due to very light sets where previously heavy sets had occurred, and to a complete absence of surviving embryos in 1936 where light sets had occurred in 1935."

Commenting upon the Panama canal, Chemical Warfare and Pacific Coast tests, the committee said as follows:

"The Panama Canal tests continue to show the high resistance of several of the tropical timbers under test. So far as is known, no advantage has been taken of this information by engineers responsible for wharf construction.

"Because of the imperfect treatment of the Chemical Warfare tests pieces, it appears probable that these pieces will be destroyed before anything is learned as to whether the chemicals added to the creosote have given added protection.

"The Pacific Coast tests still fail to yield any information as to the relative value of the different creosotes, and while the old Southern Pacific piles begin to show some attack, it is not yet serious. The oldest of these piles have been in service nearly 50 years."

That part of the report received from the Sea Action Committee of the Institute of Civil Engineers—England, is of par-

* Supervisor Tie & Timber Department, Chicago, Rock Island & Pacific.

ticular interest this year since it is a comprehensive summary of the work done and of the results obtained through the 15 years' work of the committee. In this summary are included a large number of conclusions arrived at by the committee.

Termites

In a brief progress report, the committee presented three photographs of termite destruction of a 12-in. by 12-in. Douglas fir post removed from the outbound freighthouse of the Atchison, Topeka and Santa Fe at China Basin, San Francisco, Cal. Referring to these photographs, it called attention to the extremely effective manner in which termites will destroy the inside of a structural member, and then pointed out that termites first attack the springwood and then eventually the remaining inside wood until there is practically nothing left.

Other Subjects

In addition to the above subjects reported upon, the committee presented an outline of its field of work, and indicated progress in its study of the revision of the Manual; effect on the preservative in treated ties in track due to the blowing off of locomotives; the incising of all forest products materials; and investigations being made for the determination of the toxicity value of creosote and creosote mixtures.

This report was accepted without discussion.

Report on Track

C. J. Geyer, Chairman*

Reporting in detail upon 8 of its 11 assignments, the committee covered a wide range of subjects having to do with track materials and construction, and recommended a number of additions to and revisions of the Manual and the portfolio of standard trackwork plans.

Revision of the Manual

The feature of the work in connection with revision of material in the Manual and Standard Trackwork plans had to do with revisions in Plans Nos. 600 to 610, inclusive, covering railbound manganese steel frogs, brought about largely as the result of an investigation undertaken by the Standardization committee of the Manganese Track Society as to the cause of unsound metal found in certain portions of manganese steel inserts in railbound frogs. As a part of its report, the committee included a report by the Manganese Track Society on the results of its investigation, together with the recommendations proposed by the Society to overcome the difficulty encountered through the premature failure of manganese steel inserts for frogs, particularly at the tread surface over the bolts. After considering the report of and conclusions of the Society, the committee formulated a number of recommendations concerning the castings for railbound frogs for rails six inches or more in height. These were presented as follows:

(1) That bolt shrouds be eliminated from frog castings.

(2) That cross-ribs between the side walls be "S"-shaped.

(3) That the above cross-ribs be attached to side walls only.

(4) That cross-ribs be placed approximately every second bolt spacing and occur between bolt holes.

(5) That the I-beam design be substituted for the inverted "U" design in the heel extension.

In line with these general recommendations, the committee proposed a number of specific changes in Plans 600 to 610, inclusive, and presented revised plans incorporating these changes.

In another section of its report, the committee presented new "Errata and Revisions of Plans" sheets for the portfolio of standard trackwork plans, and proposed numerous changes, mostly of a minor nature, in a number of the standard trackwork plans. Most of these latter changes were designed to make the plans conform with revisions proposed in the railbound frog plans. Several minor changes were also recommended in connection with the standard plans for tie plates.

All the recommendations of the committee were adopted.

Fastenings for Continuous Welded Rails

This year, following detailed investigations of the installations of continuous welded rails on the Delaware & Hudson and on the Bessemer & Lake Erie, the committee discussed in its report the fundamental considerations with respect to the reactions which may be expected to result from the continuous welding of rails, with particular reference to the type of track fastening required. Going into considerable detail, the report contained examples showing the stresses set up in restrained rail with various changes in temperature, and also explained how rail fastenings react to resist these large forces tending to change the overall length of the rail. Later in the report, the committee discussed the importance of adequate tie resistance to movement in the ballast in installations of continuous rail, and the effect of a break in continuous rail as regards the size of opening which would result under varying temperature conditions.

The two types of rail fastenings observed by the committee in the Delaware & Hudson and Bessemer & Lake Erie installations were the GEO and M. & L. fastenings, respectively. Concerning these fastenings, the committee pointed out that they showed the three following fundamental characteristics in the installations inspected:

(1) The type of fastening fixed the rail against lateral movement on the tie—having double shouldered tie plates securely fastened to the tie.

(2) The fastening held the rail so securely to the tie that the tie would be lifted out of the ballast before the fastening would give way—this to hold the rail from buckling in hot weather.

(3) The fastening prevented the rail from moving over the tie in a direction parallel to the axis of the rail—to accomplish this the fastening must resist movement of the rail over the tie to the extent that the tie will be moved in or with the ballast.

As a part of its report, the committee presented an extract of a report on "Welding Rails Together in Track," by F. R. Layng, chief engineer of the Bessemer & Lake Erie. This report discusses the installation of welded rails on the Bessemer & Lake Erie, including a description of the section of track involved in the installation, the method of carrying out the work of installation, the force employed, and the proposed tests to be conducted from time to time to determine the action of the rail and the internal stresses set up in it as a result of temperature changes.

The three plans recommended were adopted.

Track Tools

The only track tool brought to the attention of the association in the committee's report this year was a new design of rail tong for use with cranes. Criticism of the design offered in 1935 led the committee to develop a new design that is essentially lighter in weight than the earlier design. This new design, presented as Plan 23-A, was submitted for further comments and criticisms.

Switches, Frogs, Crossings, Slip Switches, etc.

During the year, the committee gave primary consideration to curved switches. Since there are no association plans available covering the details of construction for the curved switches adopted last year, the committee, in conference with the Standardization committee of the Manganese Track Society, prepared the following plans, which it recommended for adoption:

Plan 127—39-ft. Curved Split Switch with Uniform Risers.

Plan 215—Split Switch Details for Heavy and Medium Weight Rails.

Plan 128—Location of Joints for No. 18 and No. 20 Turnouts with 39-ft. Curved Switches.

The committee pointed out that these proposed plans show all of the necessary details for the construction and application of 39-ft. curved switches. It also called attention to the fact that it has under consideration additional plans of curved switches of various approved lengths.

Tie Plates

Continuing its work on the study of standard tie plate designs, which resulted in the adoption last year of six designs for use with 112-lb. and 131-lb. RE rail, the committee offered this year for adoption and publication in the Manual, Plans No. 1A and No. 1B for use with 90 lb. RA-A rail. In addition, the committee also offered for adoption a table identified as Fig. 501, showing A.R.E.A. tie plates, (standard and proposed) appropriate for use with various rail sections and under various service conditions. This table shows the recommended use of tie plates from

* Engineer Maintenance of Way, Chesapeake & Ohio.

10 to 14 in. in length, in connection with rails having base widths from 5⅛ in. to 6 in.

In another part of its report, the committee referred to recommended changes, under "Revisions of the Manual," in tie plate plans Nos. 1 and 2, in order to adapt them for use with 100-lb. RA-A and 110-lb. RE rail sections.

Plans No. 1A and 1B and Fig. 501 were adopted.

Positions of Abutting Rails on Bridges

Collaborating with the committees on Signals and Interlocking and on Iron and Steel Structures, and also with the Signal section of the A.A.R., the committee discussed in detail in its report the limiting relative positions of the abutting rails on both fixed spans and draw spans of bridges, and proper tolerances. In introducing its report, it pointed out that the same tolerance of rail expansion should be used on fixed spans as in other portions of the track, and that where additional expansion is necessary on long bridges, switch points adjoining stock rails may be used to take up the additional expansion required over and above the general expansion at the joints. This, it pointed out is now common practice with most roads, giving the effect of continuous rail, with no additional expansion gap.

The main part of the report had to do with allowances for rail expansion on draw bridges. Summing up this part of its report, the committee said as follows:

"We recommend tolerances only for the expansion gaps at the ends of drawspans. In this regard, we recommend a tolerance of ½ in. as maximum where rails abut without additional wheel riser devices, and of 2 in. as the maximum where wheel risers or other effective wheel-carrying devices are used—together with a horizontal tolerance of 3/16 in. and a vertical tolerance of ¼ in. On lines having heavy traffic, the rails should be maintained as close together as practicable, and expansion-adjusting devices, either automatic or hand, should be used to maintain uniform minimum expansion."

The recommendations of the committee were adopted.

Designs for Cut Track Spikes

The committee offered revised designs for 9/16-in. and 5/8-in. cut track spikes. Commenting upon these new designs, the committee pointed out that they provide greater clearance between the lips and the throat, and thus facilitate the drawing of the spikes with a claw bar. It was recommended that the new designs be substituted for the designs now appearing in the Manual.

This recommendation was adopted.

Other Subjects

In addition to the reports mentioned above, the committee presented an outline of its complete field of work, and reported progress in the study of the following subjects: Corrosion of rail and fastenings in tunnels; practicability of using reflex units for switch lamp and targets; and reclamation of serviceable material from scrap and retired maintenance of way and structures machines, tools and appliances.

* * *

The New Haven's "Comet" Passing Forest Hills, Mass.

Comparative Labor Standards

(*Continued from page 472*)

transportation. It also indicates that standardization of hours within the occupations of a single industry has been carried furthest in rail and pipe line transportation, but that it is also quite general in water transportation. However, differences in hours worked within an individual establishment or in one branch of transportation compared with another do not always measure competitive difficulties to the same degree as do differences in hourly earnings. Long hours paid for at what competitors would regard as reasonable hourly rates are not in themselves a handicap to competitors, except as they enable faster or more flexible service.

However, long hours which are not accompanied by a proportionate increase in earnings are a direct competitive factor which finds expression, along with other wage-determining forces, in low hourly earnings. Many cases of this kind are found in transportation.

Necessarily, difficulty is encountered in comparing the hourly compensation of workers in the several branches of transportation. The report summarizes and evaluates the data at hand and shows, among other things, that the range of earnings of employees in a given occupation in a single branch of transportation is appreciable and almost always greater than the difference in average rates paid for like work in two or more fields of transportation. The disparity is least in the railroad industry and, where noticeable, is found mostly in the common labor occupations. A considerable degree of standardization in this sense also is found in the pipe line industry and in the offshore branches of water transportation. While the hourly pay of air transport pilots varies considerably, the variation results from differences which a formula, to which all air-mail carriers are subject, produces. The differences therefore go back to operating conditions and for this reason and others are not an internal competitive factor of large moment. The largest spreads in compensation are found in bus and truck transportation, particularly the latter. After due allowance for the influence of sectional differences in wage scales and for differences in operating conditions which justify lower compensation for some workers following an occupation than others, it remains true that these spreads within an industry are a potent competitive factor.

The report also deals with the relative economic security enjoyed by the worker and the relative degree to which orderly employer-employee relations are possible in the several fields of transportation. The latter subject, concerned as it is in large part with the role of employee organizations, deals with means to better hours or pay or greater economic security. It is also concerned, however, with matters which are more intimately connected with the individual employee's relation to his job.

The differences in labor standards noted reflect, in varying degrees, the free play of competitive forces, the intervention of government, and the influence of organizations of employees. Labor organizations have had a long history in the railroad field and have been an effective agency for the promotion of the welfare of the workers; airline pilots in a brief period have also developed a strong union organization; vessel personnel and longshoremen in the offshore trades have become extensively organized in recent years, but have not advanced as far as have railroad employees; elsewhere in water transportation, organization is absent or relatively limited; drivers and, to a less extent, shop and terminal workers in bus and truck transportation have become more strongly organized in recent years, and work under negotiated agreements in a considerable number of cases, though relatively more so in the truck than in the bus field; union organization in the pipe line field has not made great headway.

Machinery for the orderly negotiation of labor agreements and adjustment of disputes, provided by the amended Railway Labor Act, is available not only to railroad but to airline employees. Workers in other branches of transportation are protected in their right to organize by the provisions of the National Labor Relations Act and have at their disposal the conciliation services of the Federal and State departments of labor. The need for more effective machinery varies from one to another of these branches of transportation. At this time the greatest stress in labor relations is found in water transportation. The recent strike dramatically illustrated the results of the lack of effective procedures.

Signal Section Convenes in Chicago

E. G. Stradling
C. I. & L. Chairman

Two-day program includes reports on economies effected by signaling, new aspects and rules for higher speeds, and descriptions of modern equipment

B. J. Schwendt
N. Y. C. Chairman-Elect

EXPLANATIONS of new signal aspects for higher train speeds, studies of economies and new developments in signal equipment, and instructions for maintenance forces were outstanding features of the forty-third annual convention of the Signal Section, A. A. R., at the Stevens Hotel in Chicago on Monday and Tuesday, March 15-16. E. G. Stradling, superintendent of telegraph and signals of the Chicago, Indianapolis & Louisville, presided at the meeting, at which were presented the reports of nine standing committees. The attendance was 442, an increase of 24 over that of last year. R. H. C. Balliet, secretary, reported the membership in the Section to be 1,733.

Chairman Stradling opened the meeting with a brief address and then introduced Elmer T. Howson, western editor of the *Railway Age,* who gave an address challenging signal officers to study current problems of train operation. In presenting the report of the Committee on Signaling Practice, the chairman called on S. N. Mills, assistant director of the Bureau of Safety, Interstate Commerce Commission, who also spoke.

At the conclusion of the session on Tuesday afternoon the following officers were declared elected and were installed: Chairman, B. J. Schwendt, N. Y. C., Cleveland, Ohio; first vice-chairman, E. P. Weatherby, T. & P., Dallas, Tex.; and second vice-chairman, J. S. Gensheimer, Penna., New York. In addition to the officers, the new Committee of Direction includes: R. D. Moore, S. P., San Francisco, Cal.; B. W. Molis, D. & R. G. W., Denver, Colo.; E. W. Reich, Reading, Philadelphia, Pa.; E. G. Stradling, C. I. & L., Lafayette, Ind.; C. A. Taylor, C. & O., Richmond, Va.; J. P. Muller, B. & M., Boston, Mass.; S. W. Law, N. P., St. Paul, Minn.; G. H. Dryden, B. & O., Baltimore, Md.; M. A. Baird, Erie, Cleveland, Ohio; G. K. Thomas, A. T. & S. F., Topeka, Kan.; J. A. Johnson, M-K-T, Denison, Tex.; and H. G. Morgan, I. C., Chicago.

Address of Chairman Stradling

During the past year, droughts. dust storms, floods and sleet storms have wrought serious damage to railroad equipment and facilities. I want to give due credit and praise not only to the members of the Signal Section who represent the supervising forces, but also to the rank and file of the signal departments on the railroads who labored so heroically to restore service on their respective lines.

The remark has been made that one wonders why it is that so few are ever promoted from the signal departments of the railroads into the operating department. Upon reflection, I believe we may find that the art of signaling is such a fascinating vocation that it is apt to cause one to forget that he is taking a part in a general transportation game, and he loses sight of his opportunity to attract the attention of those who have to do with the larger field of railroad operation.

I call your attention to the urgent need of more uniform laws, throughout the several states of the Union, to cover highway traffic at railroad crossings. No body of men is more familiar with the subject than the members of the Signal Section. Therefore, we should be prepared to avail ourselves of any opportunity to urge the various state legislatures to promote uniform laws to safeguard and guide the interstate highway traveler.

For the past few years we have been passing through very trying times, but the indications now point to a change for the better, and with that change will come greater opportunities for the signal departments to assist their managements to increase revenue and profits. This is essential with today's increased burden of taxes and other expenses. With the increased demand for signal facilities, the railroads will appreciate and feel the results of the good work done by the Signal Section.

Address of Elmer T. Howson

As members of the Signal Section, your consideration of and action on proposed specifications and standards for signal equipment is a commendable activity. I question, however, whether this activity constitutes a full measure of your responsibility to your railroads or to the industry as a whole.

These are changing days, and many of the numerous revolutionary developments in railroading within the past few years affect signaling. In passenger service, air-conditioning, new types of trains, lower fares, reductions in schedules that cut hours and even days off travel time, have been effective in bringing passengers back to the railroads. And the developments have been equally marked, although less spectacular, in freight service where storedoor pick-up and delivery and faster schedules are bringing much traffic back to the rails.

These developments are of very direct interest to you by reason of the new problems that they present. Upon you rests the responsibility for so revising and respacing your signaling facilities that the trains of today and of the future will move with the same safety and the same freedom from delay that have characterized the operation of their slower-moving predecessors of yesterday. It is true that these super-speed trains are as yet

few in number, but they are increasing rapidly and, like a prairie fire, are bound to spread in all directions. The forehanded railway officer will familiarize himself with this trend and will prepare to meet it in advance of its actual arrival.

Whether we like it or not, we are in a speed age, and the railways must provide this service if they are to merit and to win public patronage. That signal officer will serve his railway most effectively who does not wait for requests from his management, but takes the initiative in studying his facilities to determine, at leisure, the changes that will be required to make such schedules most effective when this new service is determined upon.

These new trains, while spectacular, serve also to dramatize the transformation that is taking place in all service. In a day when even the most lowly freight shipment moves on "red ball" schedules, every delay becomes of serious proportions. This again presents opportunities—and responsibilities—to the signal engineer. As one who has been trained to detect and analyze conditions that are conducive to train delays, he owes it to his management also to so familiarize himself with the characteristics of his heavy traffic lines as to enable him to determine those measures that can increase the flexibility and promote the speed of train movements.

It must be recognized also that the development of these newer standards of service has in no degree lessened the pressure for the conduct of railway operations with safety and economy. You have already done much in this direction. Much more remains to be done, and this will be more difficult to detect because the obvious are first considered. As traffic returns, and as this traffic requires a speed of handling never before approached, new tight points will develop.

In still another direction a new field is opening to you. The railways have been slow to recognize obsolescence; they have much to learn from other industries, especially the utilities, in this direction. The common attitude among railway men is that a device should be used until it is worn out. As a result, the railways are cluttered up with much equipment that is "eating its head off" in operating and upkeep costs. It is found in the shops and on the track; it is found also in signaling facilities. It is the price that one pays for progress. Its accurate diagnosis constitutes a challenge to alert signaling officers.

Signaling has made great contributions to the efficiency of railway operation in recent years. No branch of railway service has done more. In the days that are immediately ahead, you face still greater possibilities.

Remarks by S. N. Mills

At each of the last two annual meetings of the Signal Section I reported that none of the accidents investigated by the Bureau of Safety during the preceding calendar year was due to any failure of block signal, cab signal or automatic train stop or automatic train control devices to function as intended. I regret that I cannot make a similar favorable report this year.

During 1936 there were two accidents in which signal systems were directly involved. In one case the signal control circuits were not broken through the proper track relay, and this condition resulted in the display of proceed indications for a following train when the track section involved was occupied. A rear end collision between two passenger trains resulted, causing the death of 1 railroad employee and injury to more than 50 persons.

The second accident referred to was caused by a proceed signal indication being improperly displayed, due to changes in the signal control circuits which had been made by a signal maintainer and which made it possible to line up a conflicting route when an opposing train was approaching under a clear signal indication. The result in this case was a head end collision between two freight trains, causing the death of one employee and the injury of three employees.

There was a third case in which there was considerable question whether proper signal indications were displayed. In this case a passenger train entered an open switch and collided with a freight train on the siding, resulting in the death of one employee and the injury of five persons. The investigation disclosed that a reinforcing bar bolt had become lodged under the switch point or between the switch point and the stock rail in such position that the switch could not be closed and locked; however, due to the location of the bolt, about five feet back from the point, and due to lateral play in the switch assembly, it was possible by the use of considerable force to move the switch point far enough toward its closed position to close the switch circuit controller contacts and thus cause the signal at the approach to the switch to assume proceed position. The flagman of the freight train made a number of attempts to close the switch as the passenger train was approaching, and the investigation indicated that a proceed indication was displayed, momentarily, at least, with the switch partly open.

These investigations forcibly direct attention to the constant need for inspection, checking, testing and proper maintenance of railway signal devices. The high degree of reliability of railroad signals is the result of proper design, construction and installation in the first instance, and from then on, by constant, unremitting, careful, intelligent maintenance; and such maintenance must be of the type which prevents failures rather than that character of maintenance which merely corrects defects after trouble has occurred.

During the depression, with reduced forces and reduced working time, there were numerous cases where current signal maintenance was not kept up to the previous high standards; however, in recent months, with increased time devoted to maintenance and in many cases maintenance forces restored to normal strength, marked improvement should result.

In this connection it seems appropriate to direct attention to the fact that in a considerable number of instances the standards of maintenance for automatic train control and cab signal devices are not on an equality with the maintenance standards of signal systems. For example, inspection has disclosed instances where locomotive relays, notwithstanding the relatively severe service conditions to which they are subjected, have been in continuous service for as long as eight or nine years without being overhauled. Make-shift repairs in amplifier units have been observed which would not be tolerated in wayside signal apparatus and should not be permitted in any devices of this character. Grounds on locomotive electrical circuits are sometimes permitted to continue for several days before being eliminated, and test equipment at engine terminals is frequently found out of gage or with improper current values.

In recent months there have been several serious and disastrous railroad accidents, in our reports upon which attention has been directed to the need for additional protection. These have included accidents on lines not equipped with block signals, where traffic fully warrants the use of the block system; lines on which the block signals in use do not furnish the full measure of protection of modern signal systems, and lines on which consideration of the need of protection in addition to wayside signals, which would be afforded by train control or cab signal devices, is fully warranted.

In its report of November 26, 1928, the commission directed attention to the responsibility of the carriers to provide adequate protection, among other things, against "collisions in territory not protected by block signals," and "to provide additional protection where needed in territory now equipped with block signals." While the programs of the carriers for the extension of safety devices have been greatly retarded during the period of business depression, it is expected that with increasing traffic the installation of necessary protective devices and systems will likewise be resumed.

Economics of Signaling

C. A. Taylor, Chairman*

The report of the Committee on Economics of Railway Signaling included explanations concerning the costs involved in stopping trains; costs of maintaining and operating centralized traffic control and automatic block signaling; economic advantages of slide-detector fences; primary battery saving; train operation with reduced number of main tracks; economics of changing from automatic train control to automatic cab signals; time saved where freight trains are operated by signal indication; also extended discussions concerning methods of forecasting and

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proving the economic value of signaling; and the economic relation between signals, track, motive power, and methods of operation. Abstracts of several of these reports follow.

Costs Involved in Stopping Trains

At the convention in 1936, this committee presented a preliminary report on the cost of stopping trains, which outlined in brief the factors to be considered. The report presented this year explained in considerable detail the methods of comparing the cost of coal with that of electrical energy at the locomotive. The committee has also prepared charts showing the energy lost on account of train stops. As an adjunct to the completion of the calculations, ten additional working charts have been developed, each based on certain factors to be considered.

The effect stops have on car and locomotive repair costs was considered, the committee receiving expressions to the effect that on a locomotive used in switching service the locomotive repair costs are less than they are on a locomotive used in road service, and that with the car construction of today any increased car repair costs due to stopping and starting would be negligible.

The finding of the committee at this time was that, in order to determine the cost of a given train stop or slow down, all relative data pertaining to the specific conditions must be known and considered in the calculations. It is, therefore, not practical to attempt to work up data or charts that would cover all conditions of train stops or slow downs so that a direct reading of cost could be obtained, but it is practical to set up formulae by which specific cases can be calculated when desired if the necessary data are available. Also by assuming certain conditions as average or basic, charts and curves can be developed that will read direct for the basic conditions and adjusted for specific conditions to a close approximation by use of factors which for comparative and educational purposes will be of material value.

The committee is progressing along these lines but considerable work is yet involved; that is, in collecting test data and developing characteristic braking and acceleration curves wherewith to determine the power consumed and therefrom the costs involved in stopping a given weight of train under given conditions.

The committee has prepared a form for forwarding to the various railroads interested in making tests so designed as to record sufficient data to permit a check being made of the formulae used in arriving at the costs involved in stopping trains.

Discussion

This report was presented by the chairman who emphasized that comments, criticism, and co-operation were in order since the report was not considered complete, but rather was the result of a lot of hard work in the proper direction. Mr. Taylor also pointed out that the committee had considered the general wear on locomotives and equipment in making train stops, and had come to the conclusion that it was negligible except in those cases where actual damage was done, such as the pulling of a draw-bar. He mentioned having referred to motive power people who said that the wear and tear on a locomotive was greater when operated on a through freight train than when it made numerous stops and starts, as in local freight service. One reason for this was that continued operation of the locomotive caused the pins to heat, whereas in local service the pins did not get so hot and had a chance to cool more often.

Operation with Reduced Number of Main Tracks

The preliminary report on the Chicago, Milwaukee, St. Paul & Pacific temporary track conversion, made in 1932, is contained in the Signal Section's 1932 Proceedings, and described further in an article in the *Railway Age* of August 20, 1932. In 1935, the railroad decided to retire the facilities temporarily abandoned, rearrange the short double-track sections, move the signals to single-track locations, and generally base the track and signal plan on the operation under single track since 1932. These changes were completed late in 1935, and the following report is, therefore, based on the final charges, rather than the estimated results included in the previous report.

The conversions from double to single track to the extent shown in the table were made within a distance of 195 miles on the Iowa division between Marion, Iowa, and Manilla, and within a distance of 270 miles on two sections of the Hastings and Dakota (H. & D.) division from Tower E-14, Hopkins, Minn., to Aberdeen, S. D. The final study on the effect of removing portions of the second main track are shown in the accompanying table.

	Miles of second main track abandoned				Miles of new or lengthened siding not formerly second main			
					Converted from			
Division	Taken up	Converted to siding	Converted to other tracks	Total	Constructed	other tracks	Total	Miles of siding retired
Iowa	88.66	13.45	....	102.11	0.32	0.33	0.65	11.81
H. & D. ..	74.07	16.31	0.05	90.43	4.45	0.34	4.79	10.40
	162.73	29.76	0.05	192.54	4.77	0.67	5.44	22.21

Number 20 turnouts with spring switches were installed at the ends of double track, 13 such layouts being located on the Iowa division and 5 on the H. & D. division, as well as 1 siding switch on the H. & D. Mechanically-operated facing-point locks were installed at seven of the spring switches on the Iowa division where the movement from single to double track is made on tangent track, which avoids the necessity of restricting the speed of trains. On the H. & D. division, the locking device was installed on the siding switch only. Where the entrance to double track is made through the turnout, and a speed restriction of 35 m.p.h. is in effect on account of the turnout, the facing-point locks were not installed.

The two-block, three-indication, upper-quadrant semaphore type signal system was converted into a single-track A.P.B. system on the sections when the second track was removed. The number of signals before and after the changes were completed remain approximately the same.

Summary

Converting 209.5 miles of double track to single track on 465 miles of lines on the Chicago, Milwaukee, St. Paul & Pacific effected the following results:

First—Expenditures and credits for track and signals.

(a) Required a cash expenditure of.....$ 227,743
(b) Reduced capital account by.....$3,251,330
(c) Showed a profit and loss expense of.....$2,454,161
(d) Showed a credit for salvaged material of....$ 943,206
(e) Resulted in a net credit of.....$ 715,463

Second—Decreased cost of maintenance and effect on cost of transportation.

(a) Decreased track and signal maintenance.$187,351 per year
(b) Increased cost of transportation.....$ 11,357 per year

Third—Return on investment.

(a) Showed a net saving of $175,994 per year on the cash expenditure of $227,743 or 77 per cent on the investment.

Taxes were not decreased by reason of the reduction in the capital structure.

Where the volume of traffic on double track has decreased to such an extent that the expense of double-track operation cannot be justified, the economic advantages of operation with a reduced number of main tracks should be considered.

Freight Train Time Saved

As a supplement to information presented in previous reports, the committee presented additional data explaining the freight train time saved where trains are operated by signal indications. The tables included in the report gave data concerning 19 different centralized traffic control installations on 17 different roads, totaling 563 road miles, or 657 track miles. The average saving in freight train time per installation amounted to 35 min., or 1.38 min. per freight train mile. The minutes saved per freight train mile varied from 0.27 to 4.29 on the 19 installations. If the time saving up to 40 trains per day is plotted on a trend curve, the curve shows that the percentage of freight train time saved varies nearly as the number of freight trains per day, i. e., 20 per cent time saving for 20 trains, 30 per cent time saving for 30 trains, and 40 per cent time saving for 40 trains. In fact, below 30 trains per day the trend curve runs higher than the number of trains. In eight cases, additional tonnage and increased gross ton miles per train hour resulted from the improved operation.

Forecasting and Proving the Economic Value of Signaling

The purpose of the "forecasting" section of this report is to set forth methods for setting up assumed operating arrangements and conditions on a railroad so that the results may be evaluated and compared with either existing or assumed conditions. It comprises two distinct steps or processes, as fol-

lows: Determining the quantity of saved units; determining the value of saved units. The physical organization of a railroad may be divided into three general classifications, as follows: Permanent way, rolling stock, and operating means. The operating means are of primary concern. That is to say, being given the permanent way and rolling stock, there remain the means for operating the trains over the permanent way with minimum interference. It is immaterial what the existing operating means are; whatever they may be, the results are known from experience. The real problem is the determination of the results from the assumed means, and when determined they may be compared with the results obtained from the existing means. Occasion may arise to forecast the comparative results from two different assumed means. Then the over-all results may usually be obtained by comparing the results of each with the results from the existing means.

In "proving" the economic value of signaling, the procedure is to compare an existing system or operating method with one that was previously in effect. It involves the use of the same general processes as in the case of forecasting.

Discussion

This report was presented by S. N. Wight (General Railway Signal Company) who drew attention to the fact that it was a revision of a report which was presented in 1934, the major change involved being the enlargement of the scope of the investigation to include not only methods of forecasting but also methods of proving the economic value of signaling. Mr. Wight requested co-operation in the preparation of more definite methods of obtaining costs of the various items involved.

Cost of Maintenance and Operation

In order to make a comparison between the cost to maintain and operate centralized traffic control and the cost to maintain and operate automatic block signals, information has been obtained covering five C.T.C. installations and three automatic block signal installations. The first comparison covers an installation of C.T.C. on the Wabash between Salt Line, Ind., and Lafayette Junction, made in 1931. This territory was previously equipped with automatic block signals, installed in 1914.

State Line to Lafayette Junction, Ind.

	Value of A.A.R. units	No. of track miles	No. of road miles	Total cost of installation	Annual cost of maintenance and operation	Year costs taken	Annual Maintenance and Operation Cost: Per A.A.R. unit value	Per track mile	Per road mile	Per cent of total cost of installation
Automatic block signals	618	37	37	$41,120	$5,865	1930	$9.49	$159	$159	14.3*
C.T.C.	932	37	37	182,380	8,272	1934	8.88	224	224	4.5

The second and third comparisons cover two C.T.C. installations on the Missouri Pacific, made in 1931. In each case the automatic block signal territory used in the comparison was in the same operating district as the C.T.C. installations and the maintenance was on the same basis. Both automatic block signal installations were made in 1929.

	Value of A.A.R. units	No. of track miles	No. of road miles	Total cost of installation	Annual cost of maintenance and operation for 1934	Annual Maintenance and Operation Cost: Per A.A.R. unit value	Per track mile	Per road mile	Per cent of total cost of installation
Etlah to Isbell, Mo. ABS	1072	78	39	$254,000	$8,000	$7.46	$103	$205	3.1
Rose Hill to HD Jct., Mo. CTC	1515	69	36	312,814	10,000	6.60	145	278	3.2
Higginson to Cabot, Ark. ABS	486	48	24	144,000	4,500	9.26	94	187	3.1
Diaz to Bradford, Ark. CTC	735	36	19	145,000	4,500	6.12	125	239	3.1

ABS=Automatic block signals.
CTC=Centralized traffic control.
* The per cent of total cost in this case is exceptionally high with automatic block signals on account of 1930 maintenance and operation costs being compared with 1914 installation costs.

It will be noted that in each comparison the cost to maintain C.T.C. is less per A.A.R. unit value and more per mile than the cost to maintain automatic block signals. This is to be expected, as there are more units per mile in C.T.C. than in automatic block signaling.

It will also be noted that when the automatic block signal and the C.T.C. installations are made about the same time (under the same cost level) the cost of maintenance and operation bear the same relation to cost of installation.

Economic Advantages of Slide-Detector Fences

The construction of a fence along a railroad right-of-way, between the track and the slope or bluff from which rock or dirt slides frequently occur, and utilizing circuit breakers on the fences to control circuits of the automatic block signals so that the signals will display their most restrictive indication when a rock strikes the fence, constitute, in brief, what is known as a slide detector fence installation. The report as presented explained the construction and cost of slide-detector fences on several roads and abstracts of the report follow:

The cost of a slide-detector installation depends on the local conditions, governing the height and length of the fence required, on the difficulties encountered in construction and as to whether additional signals are required. On the Northern Pacific the lowest unit cost was 44 cents per foot on an installation of a single-tier fence when the posts were set in dirt. On a two-tier fence where the posts were set in rock, the cost was $1.90 per foot. On the Norfolk & Western the costs varied from a low of 53 cents to $3.15 per lineal foot, with an average of $1.14. On the Pennsylvania the costs ranged from 92 cents to $2.40 per lineal foot, and a typical installation on the Southern Pacific cost $1.43 per foot.

Likewise, the saving effected by the fences in the elimination of watchman service varies depending on the locations being considered. The fences on one division of the Northern Pacific cost $4,927 and effect an annual saving of $2,900. An installation of seven fences on the Norfolk & Western resulted in the elimination of a monthly operating expense of $1,150 for part-time watchman service, at which rate the fences paid for themselves in approximately one year. On the Pennsylvania three installations costing $14,610 effect an annual saving of $2,065.

The use of detector fences provides many advantages over and above the economies effected by the replacement of watchmen. The protection is effective in giving instantaneous notice of rock or ice slides 24 hr. every day, whereas it is impracticable to employ enough watchmen to provide effective patrol over entire slide areas at all times and have the men in position to stop trains quickly in the event of hazard. Therefore, some roads consider the improvement in protection afforded by the fences to be the deciding factor, providing the proposed savings in operating expense will offset the carrying as well as the maintenance charges. On the Northern Pacific the maintenance of the fences averages about 5 cents per lineal foot annually.

Relation of Signaling to Other Railroad Facilities

The committee also presented an extended symposium by B. J. Schwendt (N. Y. C.) dealing with the Economic Relation between Signals, Track Arrangement, Motive Power, and Methods of Operation. This paper, together with illustrations, took 51 pages in the advance notice of the meeting. An abstract of this paper is not presented here, but complete copies, bound separately, are available to railroad men interested in this subject.

Discussion

J. H. Oppelt (N. Y. C. & St. L.) commented on Mr. Schwendt's paper, in part, as follows:

"The methods used by Mr. Schwendt in reaching his conclusions appear to be logical and his figures as to values can practically all be substantiated by statistics. However, there seems to be some difference of opinion regarding the value of a freight train hour. A value of $9 per hour has been used and it is stated that this is 'about equal to overtime wages, extra fuel and supplies.' It would appear that there is more to be considered than wages, extra fuel and supplies. If a fast freight train is running an hour late, particularly on a single track railroad, there is bound to be more or less confusion, delay, and disruption of schedules of other trains, all of which constitute items of expense.

"In considering this factor, it appears that there may be several intangibles which should be given consideration. With our present day guaranteed delivery, the missing of a connection, or fail-

ure to deliver on time, results in claims (To cite a case, claims averaged $1,000 per month on account of a certain train missing its connection. Additional signal facilities were requested in order to speed up this particular train to eliminate these claims); failure to get live stock through on time, resulting in fines and claims; likewise, failure to get refrigerator cars to icing stations on time, and in this connection I refer you to Mr. Howson's remarks this morning. These claims and fines do not appear in our operating account in a manner in which they can be used; yet they are in the picture, and if by proper signaling, interlocking, etc., the train can be moved to avoid them, why should they not be taken into consideration when figuring the value of a freight train hour which is used in developing the monetary value of signaling."

E. T. Ambach (B. & O.) called attention to the fact that "custom" often takes the place of "reason," mentioning cases where speed limitations have been placed at ends of double track whereas perfectly safe operation at higher speeds was possible under the signaling provided. F. W. Pfleging (U. P.) remarked that with the gradual elimination of speed restrictions, station stops, etc., and the provision of ample motive power, the further speeding up of trains was the problem of the signal engineer.

E. B. Smith (N. Y. C.) pointed out that in many cases speed increases were impossible as a solution to track capacity problems, due to the shortness of the route and to natural speed restrictive conditions. He called attention to the fact that a sufficient length of track must be involved to allow the partial solution of track capacity problems by increasing train speeds.

W. M. Post (Penna.) asked if, in the preparation of Mr. Schwendt's article, the fact that the cost of track maintenance rises with increased traffic had been considered in the section covering the possibility, in some cases, of reducing double track to single track with proper signaling. Mr. Schwendt replied that this was a pertinent point, and that some work was now being done with this problem by the A. R. E. A. to obtain actual figures of the average increases in track maintenance changes resulting from increased traffic.

G. K. Thomas (A. T. & S. F.) drew attention to the fact that different problems arise in the western section of the country than in the east, fewer trains being operated over longer distances at higher speeds. Mr. Thomas remarked that extending the restrictive indications in order to allow greater braking distance for higher speeds often actually reduced track capacity.

Signaling Practice

C. H. Tillett, Chairman*

The report of the Committee on Signaling Practice included descriptions of recent developments in automatic train control and cab signals, and discussions on aspects and indications for four-block signaling, signaling for increased train speeds, noteworthy changes in signal practice since the last annual meeting, possibilities of a uniform system of aspects and indications, and conditions under which trains may be operated by automatic signal indication without train orders. Abstracts of some of these reports follow:

Automatic Train Control and Cab Signals

This report gave the road and track mileage and the number of engines equipped with automatic train control and cab signals as of July 1, 1936, and listed the number of locomotives equipped for interchangeable operation on various roads. Various tests were conducted during the year, including tests of a time-element reset, designed to eliminate the reset cock on certain types of equipment, and tests of various special installations of train control and cab signal equipment designed for interchangeable operation. Attention was called to the need for service tests to determine the maximum speed at which intermittent inductive automatic train stop devices will operate to initiate an automatic brake application, under the various conditions of air-gap and offset obtaining in service.

Aspects and Indications for Four-Block Signaling

Under present conditions, the necessity for four-block indication exists to a limited extent. Where such indications are installed, it is probable that disc signals and semaphores would not be used, and, therefore, in considering aspects, position-light signals, color-position-light signals and color lights should be provided for. In its report at the 1936 annual meeting, the committee recommended an additional signal: Name—Approach-Intermediate; Indication—Approach next signal at not exceeding intermediate speed; this signal to be placed between the approach-medium and the approach signal. This intermediate signal should be placed between the clear signal and the approach-medium in high-speed territory and called approach limiting.

The Standard Code leaves it up to each railroad to define medium-speed and slow-speed. It is recommended that another definition be added, i.e., "Limited Speed"; each road to determine what this speed is to be; that the rule should be numbered 281a; Name—Approach Limiting; Indication—Approach next signal at not exceeding limited speed. Position-light signal will display for this purpose the same aspect as for the approach, with a marker light above the existing aspect. The color-light and color-position-light signals may be treated in the same way. With color-light signals, a consistent scheme for accomplishing this aspect would be to use yellow over green, in which case it would be desirable to use yellow over yellow for the approach-medium aspect. The committee recommends that if this report is approved by the Signal Section, the Committee of Direction request that the new rule be included in the Standard Code.

Discussion

A. H. Rudd (Penna.), when presenting the report of this subcommittee explained that since the report was printed further progress has been made in developing improved aspects which will be explained in a future report.

E. N. Fox (B. & M.) brought out the point that certain automatic signals serve also as approach signals for interlockings and, therefore, that aspects for both applications should be considered as a unit. On the B. & M. the signal controlling a train movement over a slow-speed turnout, No. 10, is directed by an aspect of red, over red, over green, name of signal "clear-slow," the aspect of the signal in approach being yellow over yellow, the name of the indication being "approach-slow".

F. B. Wiegand (N.Y.C.) stated that the standard code includes an aspect of yellow over red, over green, to give an indication equivalent to the B. & M. "approach-slow". Mr. Fox contended that the use of yellow over yellow permitted a better use of colors to secure a distinctive aspect.

Mr. Tillett stated that since the report was printed, word had been received that a movement had been started to revise the standard code, and that the committee would no doubt have an opportunity to advance suggestions for changes in aspects and indications.

Signaling for Increased Train Speeds

The committee called attention to the fact that the problem of signaling for higher train speeds is that of increased stopping distances, it being necessary that a restrictive indication be displayed not less than stopping distance from an obstruction.

The view of signals should be as good as practicable and aspects should be distinct. If necessary, signals should be moved, rearranged or provided with lights having beams of greater intensity to improve their efficiency. Short range signals such as disc signals should be replaced with modern types.

Owing to the many variables affecting stopping distance, very little definite information is available. Attention naturally focuses on the specially designed high-speed passenger trains. These trains, however, have special braking equipment. The real problem lies in the gradual stepping up of passenger and freight train speeds with standard equipment.

In signaling for higher speeds it has been found generally satisfactory to use three indications with minimum block lengths from 6,500 to 9,000 ft. on tangent level track. The use of a fourth indication has been found desirable in heavy traffic zones, particularly where slower speed traffic is operated on the same tracks with high-speed trains.

The results obtained by the use of three or four-block signaling are illustrated in Fig. 1 which shows the minimum distance which must intervene between the rear end of a train and the front end of a following train, in order that following train may

* Signal Engineer, Canadian National.

receive a clear signal, and have 8,000 ft. stopping distance beyond the first approach signal.

There is so little advantage of a five-indication four-block system over a four-indication three-block system for spacing high-speed trains that the five-indication system has not yet been

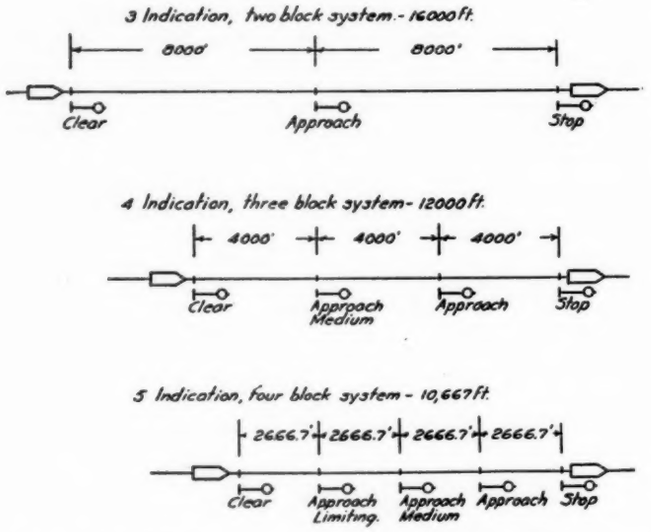

Fig. 1. Track and Signal Layout Required for Use of Multiple-Aspect Signal to Secure 8,000 ft. Stopping Distance

used much for this purpose. The five-indication system has been used in dense traffic areas where speeds from 45 to 60 m.p.h. are obtained. The fifth indication is being used for high-speed train operation at special locations to govern approach to high-speed turnouts. In heavy traffic lines with short block spacing, say 5,000 ft., the change to four-indication signaling is desirable to maintain track capacity. The mileage so equipped, however, has been very small. In 1935, with 93,401 miles of track equipped with automatic block signals, only 1,059 miles were equipped with four-indication signals.

At stations and at interlockings where short blocks have to be retained, duplicate restrictive indications have been used rather than introduce a fourth indication in three-indication territory. The use of duplicate restrictive indications is objectionable because of the extra delay introduced. There is also a tendency for enginemen to expect always to encounter two approach indications when approaching a stop signal, which may cause a stop signal to be overrun at a location where only one caution signal is displayed. Overlaps have also been used at special locations where short blocks are required. Their use is objectionable because an extra stop is required. The display of a stop signal for an unoccupied block is also objectionable.

The above statements apply to multiple-track signaling. On single-track automatic block signaling, overlaps have to be used for opposing movements and they must be extended, if required, to take care of increased speeds. The use of duplicate restrictive indications is also necessary in order to take care of opposing movements.

Discussion

H. G. Morgan (I.C.), when presenting the report on this subject, explained that information received since the Advance Notice was printed, indicated that during 1936 four-block signaling was installed on 240 track miles using 205 signals, which figures, together with those for isolated sections, bring the 1936 totals to 456 track miles using 345 signals.

Noteworthy Changes in Signal Practice

A description was given of roller bearings for switches, tests of which show reduced power requirements of approximately 60 per cent. The device provides for the support of practically the entire weight of the switch on roller bearings, while in transit. However, when a train travels over a switch equipped with this device, the switch is supported by tie plates in the usual manner. It utilizes a multi-leaf cantilever spring secured to the stock rail which engages with the roller mounted in a bracket bolted to the switch rail. The spring is so proportioned as to provide a yielding support for practically the entire weight of the switch rails which rest on the roller bearings. The power requirement variations are particularly noticeable where the lengths of switches have been increased to 45 ft., with a corresponding increase in the weight of rail to 131 or 152 lb. Dragging-equipment detectors have been developed to actuate the signal system so that enginemen are informed of low-hanging equipment on their trains. (For description of dragging-equipment detectors, see page 725 of the *Railway Age* for November 14, 1936.

Discussion

W. M. Post (Penna.), in presenting the explanation of the roller bearings for switches, explained that for power-operated switches using 45-ft. points, two bearings are used under each point. On one switch about 1,500 ft. from a tower, and operated by a mechanical plant, three bearings were used under each point.

W. H. Stilwell (L. & N.) inquired what special signal aspects were used to indicate to an engineman that a dragging equipment detector had been operated, so that the engineman would know that the signals had been set by the detector. Mr. Post explained that no special aspects had as yet been developed for this purpose, but that the necessary information was conveyed to the engineman. In cab signaling territory the wayside signal ahead of the train indicates "approach," and the cab signal "caution—slow speed." This unusual combination of aspects indicates detector control. Outside of cab signal territory the wayside signal indicates "stop." In all of the installations the towerman gets an indication that the detector has operated, and he instructs the train crew to inspect the train for dragging equipment.

As used so far, the detectors are located in the approach to interlocked switch layouts, because dragging equipment is likely to cause trouble at such locations. In cab signal territory the detector is located maximum train length plus 1,500 ft. in the approach to the home signal. Even if dragging equipment is near the rear of the train, the engineman will see the change in the signal aspect when at least 1,500 ft. from the signal. In this extreme example, even if he over-runs the signal, the dragging equipment will not have yet arrived at the turnouts. Outside cab signal territory the detectors are located in approach to the distant signal.

Uniform Aspects and Indications

The committee stated that at the present time there is no possibility of providing a uniform system of aspects which would be adopted by the railroads.

Conditions Under Which Trains May Be Operated by Automatic Signal Indication Without Train Orders

The committee recommended that trains may be operated by signal indication without train orders for normal movements: For one-direction operation, with centralized traffic control, with manual block, with controlled manual block, with automatic block signaling, and with interlocking; for either-direction operation, with centralized traffic control, with controlled manual block, with automatic block signaling in one direction and traffic locking in the reverse direction, with automatic block signaling for operation in either direction and manual supervision of entrance signals, and with interlocking.

Report on Highway Crossing Protection

P. M. Gault, Chairman*

The report of the Committee on Highway Crossing Protection included a specification submitted primarily for use in preparing a specification for the installation of highway grade crossing signals in connection with the federal program for protection of grade crossings, and a revised set of requisites for highway grade crossing signals, being the present requisites revised to make them comply with present requirements. The re-

* Signal Engineer, Missouri Pacific.

vised requisites have enlarged sections covering "mounting," range and spread, and lenses or roundels. The flashing-light range and spread requisite, as proposed in this specification, reads "Each flashing-light unit shall provide a front indication having a beam candlepower of uniform intensity at any angle up to 15 deg. on either side of the axis and the range at any point in the 30-deg. angle under bright sunlight conditions with the sun at or near the zenith, shall be not less than 1,500 ft. when a 10-watt lamp rated at 1,000 hr. is burned at rated voltage," range being the distance at which the indications will be clear and distinct to a person with normal vision. Likewise, with reference to the wig-wag type, "The signal light, when the disc is suspended vertically, shall have a range at night of 1,500 ft. through a total angle of not less than 30 deg. when a 10-watt lamp, rated at 1,000 hr., is burned at rated voltage." Another requisite is that "Each flashing-light unit having a back indication shall have sufficient adjustment and a beam of sufficient spread and intensity to give an indication over at least half the highway adjacent to the signal on the opposite side of the railroad."

Discussion

J. H. Oppelt (N. Y., C. & St. L.) raised the point with regard to the revised A. A. R. Requisites for Crossing Signals that some states require that the signals operate until the rear of the train clears the crossing, and asked if some consideration should not be given this fact in the section on circuits. W. M. Post (Penna.), who submitted the report on this subject, replied that the committee did not think it wise to make this a requisite. Mr. Post then stated that the committee desired to change the 15-deg. requisite in the range and spread section to 10 deg., and thus the angle in which the range was specified to 20 deg., in order to make the specification less strict. G. H. Dryden (B. & O.) asked if a section covering the problem of phantom indication elimination should not be inserted. A. H. Rudd (Penna.) implied that since phantom indications did not flash alternately they were not of serious consequence. Mr. Dryden then brought out the point that phantom indications should be avoided due to confusion resulting to the public, leading in some cases to the public ignoring the signals when they really were flashing. Mr. Post said that the committee considered that this problem is still in the experimental stage, that the time was not ripe to provide requisites regarding the elimination of phantom indication, and that the committee was unprepared to insert a requisite covering other subjects at this time. Following this discussion the revised requisites were accepted for submission to letter ballot, as modified in small details at the presentation.

After the reading of the specification covering highway grade crossing signals in connection with the federal program for protection of grade crossings, C. A. Dunham (G. N.) read a statement questioning the fact that the specification did not cover rotating disc signals. Mr. Dunham stated that 40 per cent of all grade crossing signals installed in the United States during 1936 were of the rotating disc type. P. M. Gault (M. P.), chairman of Committee VIII, stated that the Signal Section had so far considered the rotating disc as an attachment, and for that reason the committee had limited itself to covering the flashing-light and wig-wag type. Mr. Gault said that if the Signal Section desired that the committee prepare specifications covering the rotating disc type of signal the committee would be glad to do so. The specification was accepted, however, with certain minor modifications, for submission to letter ballot, as modified.

Other Committee Reports

The Committee on Overhead and Underground Lines submitted two specifications, one covering fibrous-covered nonmetallic sheath for railway signal cable, the other covering copper-covered steel guy and messenger strand, for acceptance for submission to letter ballot, and recommended the use of the T. & T. Section, A.A.R. specification for bronze guy and messenger strand.

The report of the Committee on Interlocking contained revised specifications, to meet present-day requirements, for electric interlocking, electro-mechanical and mechanical interlocking, centralized traffic control system, centralized traffic control machine. A new specification was presented for discussion, covering protection for drawbridges.

The Committee on Designs presented 23 revised drawings for signal equipment superseding previous designs, recommended that 5 drawings be removed from the Manual, the practice for which these drawings were developed being considered more or less obsolete, and presented 4 new drawings. The committee also presented revised forms of specification 15533 covering railroad-highway grade crossing signs, specification 15633 covering reflector units, and presented a new specification, 174-37, covering electric lamp cases of new design for electric lighting of semaphore signals for night indications.

The report of the Committee on Materials Research recommended the removal from the Manual of specifications 1911 for illuminating oil, and 13324 for motor gasoline, recommended the withdrawal of assignments on specifications for non-corrosive soldering flux and for porcelain, submitted specification 177-37 for insulating material for filling and sealing recesses in signal apparatus, and submitted specification 172-37 for air-depolarized carbon caustic soda primary cells, revised to include revisions suggested in the 1936 annual meeting. The report also included the co-operative report, American Standards Association—Electrical Insulating Materials in General.

The Committee on Contracts and Instructions reported on the general classification for signal interruptions, summarizing the reports of 96 different railroads on this subject, and recommended a revised general classification for signal interruptions to supersede subject matter in the Manual. Instructions for maintaining, inspecting, and testing spring switches were submitted for acceptance for submission to letter ballot, as was a form for performance reports for automatic highway grade crossing protection. A set of rules for the handling of trains through automatic interlockings in case of failure was submitted and discussion recommended. The section of "American Railway Signaling Principles and Practices," dealing with lightning protection, was also submitted for discussion.

The Committee on Automatic Block Signaling submitted revised requisites for direct-current automatic block signaling circuits, revised requisites for minimizing the effect of lightning on direct-current track circuits, and a progress report on protection against lightning. The committee also present revisions of specifications covering the following subjects: Tractive-armature, direct-current neutral relay with two or more contact fingers; tractive-armature direct-current neutral relay for series-line approach lighting; alternating-current relay; switchboard; transformer, oil-immersed, self-cooled; alternating-current power transfer relay; and channel pin. It also submitted a revised set of a-c. track circuit characteristics. The committee reported that the assignment to prepare requisites for power-off indicators for floating battery charge was too broad a subject and recommended that the assignment be withdrawn.

* * *

Photo Courtesy U. S. Bureau of Public Roads

Signal at Crossing in Spokane, Wash., on Federal Works Program Project

N.R.A.A. Presents Large Exhibit

C. H. White
President-Secretary

More than 100 manufacturers participate in a display of products used in railway construction and maintenance

E. D. Cowlin
President-Elect

WITH 103 railway supply companies participating in the twenty-sixth annual exhibit of the National Railway Appliances Association, substantially all available space in the great hall and the north annex was occupied in the Coliseum, Chicago, during the four days from March 15 to 18, inclusive. The increase in the number of exhibitors (from 85 to 103) and the more generous use of space by some of the participating firms, showed that the association had made distinct progress during the last year.

As in the past, this exhibit is presented coincident with the conventions of the American Railway Engineering Association and the Signal Section of the Association of American Railroads. The products on display were, therefore, representative of the needs of the railways for materials and appliances used in the construction and maintenance of railway tracks, bridges, buildings, signals and allied facilities.

The officers of the N.R.A.A., who were charged with the responsibility for the preparation of this exhibit, were as follows: President-Secretary, C. H. White, Industrial Brownhoist Corp., Chicago; vice-president, E. D. Cowlin, Eaton Manufacturing Co., Reliance Spring Washer division, Massillon, Ohio; treasurer, A. J. Filkins, Paul Dickinson Co., Chicago; Directors, Thomas O'Leary, Jr., Johns-Manville Corp., Chicago (ex-officio); Philip A. Weinstein (general counsel); R. B. Fisher, Buda Company, Harvey, Ill.; T. E. Rodman, Maintenance Equipment Co., Chicago; Charles M. Hoffman, Dearborn Chemical Co., Chicago; H. H. Talboys, Nordberg Manufacturing Co., Milwaukee, Wis.; Jess Mossgrove, Austin-Western Road Machinery Co., Aurora, Ill.; and W. H. Fenley, Kerite Insulated Wire & Cable Co., Chicago.

At the annual meeting on March 16, Mr. White, president-secretary, reviewed the operations of the organization during the last year, and cited the reduction in

(*Continued on page 526*)

List of Exhibitors

Achuff Railway Supply Co., St. Louis, Mo.; rail anchors, lock washers, ratchet-action track wrenches; George W. Achuff, W. D. Achuff, Jay L. Hench.

Adams & Westlake Co., Chicago; relays, signal lamps and lanterns; A. S. Anderson, E. Andrews, U. Hedin, R. D. John, C. H. Larson, E. H. Leisch, W. G. Porter, W. A. Smith and H. G. Turney.

Air Reduction Sales Co., New York; oxygen and acetylene, gas welding and cutting apparatus and supplies, electric arc welding machine and electrodes, literature, demonstration of heat-treating rail ends with 2-flame tip; cropping rail ends with radiagraph, specimens of metals coating on bridge parts; C. B. Armstrong, A. W. Brown, J. F. Callahan, C. A. Daley, J. T. Gillespie, Jr., H. A. Hocking, J. W. Kenefic, L. T. McDowell, R. T. Peabody, U. F. Portel, M. M. Weist and D. J. Williams.

Ames-Baldwin-Wyoming Co., Parkersburg, W. Va.; track shovels and locomotive scoops; H. C. Cunningham, H. S. Bywater.

American Car & Foundry Co., New York; automatic electric steelbar heater, electric rivet heater, electric metal heaters for heat treating; W. J. Bisset, F. C. Cheston, H. C. Cheston and A. G. Wood.

American Fork & Hoe Co. (Shovel Division), Cleveland, Ohio; shovels and scoops; H. C. Branahl, J. M. Burbank, T. A. Lawson, G. L. McKewin, Frank Reagan and L. H. Turner.

American Hoist & Derrick Co., St. Paul, Minn.; photographs and literature on locomotive cranes, crawler-shovel-crane-dragline, rail cranes, derricks, hoisting engines, revolving derricks, wire rope clips, blocks and sheaves; Arthur Craine, J. L. Hickey, W. B. Maurer, R. W. Payne, S. H. Smith and H. O. Washburn.

Armstrong Paint & Varnish Co., Chicago; paints and brine corrosion preventive for bridge floors; Carl Broo, H. T. Keenan, C. W. Merriken, L. D. Mitchell, W. D. Waugh, John Witz and Tom R. Wyles.

Austin-Western Road Machinery Co., Aurora, Ill.; model and moving picture of automatic air-dump car, literature on road machinery and power shovels; H. F. Barrows, J. D. Benbow, H. B. Bushnell, J. E. Huber, Jess Mossgrove, C. S. Sencenbaugh, Bruce P. Smith.

Barco Manufacturing Co., Chicago; stove, gas hammers, tie tampers, flexible pipe joints; F. N. Bard, William Behlke, W. F. Donaldson, Charles Jenista, L. T. Lytle, C. L. Mellor, F. B. Nugent.

Barrett Co., New York; tar, bituminous road materials and grade crossing materials, protective paint coverings, samples of prepared and built-up roofing; W. F. Doriot, C. J. Harper, W. P. Hickman, L. L. Thoms and E. A. Zipper.

Barrett-Christie Co., Chicago; (Coffing Hoist Co.) hacksaw blades, chain, ratchet lever and gravity lowering hoists, electric hoists, portable electric tools, power-operated band saw and high-speed cut-off saw; J. R. Coffing, H. N. Hayes and R. P. Kemp.

Bethlehem Steel Co., Bethlehem, Pa.; positive signal stand, switch stands, gage rods, track bolts and nuts, mitered rail joint, switch heaters; spring rail brace, standard A.R.E.A. frog casting; A. K. Boot, C. H. Cecil, R. L. Gillespie, R. Knibloe, W. B. Lang, Ray Miller, J. W. Murphy, George Riddle, H. E. Stoll, S. Stoever, J. D. Tulley, M. A. Vickers and A. A. Warg.

Blatchford Corporation, Chicago; re-formed rail joints, dry battery operated Neon flashing signals, porous drain pipe; Carter Blatchford, H. B. Thoresen, L. S. Wilbur.

Buda Co., Harvey, Ill.; track jacks, tie tampers, rail bender, bumping post, car stops, track liners, re-railers, bonding drill, track drill, section and inspection motor cars, earthdrill, crossing gate, tool grinder; H. C. Beebe, R. M. Blackburn, H. S. Brown, E. D. Conant, J. S. Dempsey, R. B. Fisher, J. J. Gard, F. L. Gormley, W. H. Haas, G. W. Hoover, C. T. Miller, F. E. Place, G. A. Secor, L. O. Stratton, E. H. Walker and C. W. Wood.

Caterpillar Tractor Co., Peoria, Ill.; Diesel power unit and tractor, with power loader; G. A. Bell, W. E. Brown, W. J. Carson, Norm Donnelly, J. F. Fitzgerald, E. R. Galvin, H. M. Hole, R. J. Howard, L. S. Lord, W. W. Paape, B. C. Patten, C. A. S. Pears.

Chicago Pneumatic Tool Co., New York; air compressors, electric and pneumatic tie tampers, electric frequency changers, portable pneumatic

and electric track tools, pneumatic and electric portable tools and pneumatic and electric bridge tools; H. G. Barbee, H. L. Bradley, C. L. Butler, P. J. Christie, C. B. Coats, Guy Coffey, S. A. Congdon, Jr., H. R. Duebel, T. P. Harris, W. J. Pallowick, G. C. Vanden Boom and L. J. Walker.

Chipman Chemical Co., Inc., Bound Brook, N. J.; chemical weed killer; R. N. Chipman, N. S. Leavitt, J. D. Ruttan and J. Sanburg.

Cleveland Frog & Crossing Co., Cleveland, Ohio; frogs, crossings, switch accessories; J. A. Donahey, E. W. Goodaire, L. G. Parker, G. A. Peabody and H. I. Prentice.

Cleveland Tractor Co., Cleveland, Ohio; tractors; L. T. Burwell, T. D. Crowley, G. H. Goodell, G. F. Hoover, T. G. Moore, D. A. Milligan, R. W. Payne and J. W. Vogler.

Conley Frog & Switch Co., Memphis, Tenn.; models of expansion joints, turntable joints and self-guarded manganese spring frogs; E. H. Baumgarten, J. C. Conley, J. E. Conley, F. G. Dunbar and H. J. Elliote.

Crerar, Adams & Co., Chicago; rust preventive, portable hydraulic units, jacks and presses, tie squeezer, handles for track tools, die starter, track and bonding drills, demolition tools, pipe bender, knockout punches, pipe wrenches, fire extinguishers, tool grinders, car cleaner, cordage, cotton cords, canvas, car roofing, crayons, tools, emulsion, snow brooms, fibre, wire cable, spray equipment; G. J. Doyle, Robert Ferguson, Adolph Hawkinson, Tom Lewis, E. C. Poehler, Irving Poehler, Paul Rabe, J. K. Stewart, J. M. Temple and T. F. Tough.

Cullen-Friestedt Co., Chicago; anti-slip rail tong, moving pictures of rail crane, rail straightening machine, clamshell and lifting magnet; K. J. Beller, W. C. Bamber, L. B. Bertaux, C. J. Bronez, E. V. Cullen, F. J. Cullen, F. P. Cullen, T. G. Frazee, G. H. Goodell, R. W. Jamison, J. F. Leonard and C. E. Irwin.

Dearborn Chemical Co., Chicago; water treating equipment, pumps, chemicals, rust preventives, water testing equipment, chemical proportioning pumps, signal foam-meter, process for corrosion prevention; F. J. Boatright, D. Bodishbaugh, L. D. Brown, G. R. Carr, R. A. Carr, R. F. Carr, Jr., O. W. Carrick, Joseph Cremmer, H. B. Crocker, R. A. Doltan, E. A. Goodnow, L. O. Gunderson, W. H. Hinsch, F. B. Horstmann, S. C. Johnson, R. J. Maginn, R. Q. Milnes, A. Moeller, A. C. Moeller, S. C. Moore, A. Novak, C. C. Rausch and B. H. Stone.

DeSanno & Son, A. P., Inc., Philadelphia, Pa.; abrasive wheels and abrasive cutting machine, literature; E. E. Buckingham, R. A. Burton, J. C. Rinehart, E. J. Rohan and W. K. Whelan.

Detroit Graphite Co., Detroit, Mich.; paints; A. B. Edge, Pete Fields, L. F. Flanagan, George E. Otte, E. C. Roberts and Neil Wright.

Paul Dickinson, Inc., Chicago; smoke jacks, chimneys for small buildings, roof and deck drains, roof ventilators (full size and models), exhaust heads; P. A. Christensen, A. J. Filkins and William Harrison.

Duff-Norton Manufacturing Co., Pittsburgh, Pa.; track jack, automatic lowering jacks, ball-bearing self-lowering jacks, standard jacks, air-motor-operated power jacks, drift bolt puller, sidelift track jack, journal jacks; D. F. Evans, Walter Floyd, J. Gilchrist, George Mayer, A. Roberts, C. N. Thulin and E. E. Thulin.

Eaton Manufacturing Co. (Reliance Spring Washer Division), Massilon, Ohio; rail joint; spring washers, rail bonding washer, locomotive spring washers; E. D. Cowlin, E. C. Gross, R. L. Shireman and A. H. Weston.

Elastic Rail Spike Corp., New York; elastic rail spike; W. A. Fisher, A. C. Jack and B. Kuckuck.

Electric Tamper & Equipment Co., Ludington, Mich.; electric vibratory tampers, tooth-tip tamper blades, electric generator sets, vibrators for concrete placement, literature; G. E. Cartier, H. W. Cutshall, Corwill Jackson, D. H. Jenkins, E. R. Mason, L. S. Osborn, G. F. Swarthout, G. L. Walters, J. Webb and M. S. Westlund.

Evans Products Co., Detroit, Mich.; model of auto-stop, rail-highway truck, motion pictures; C. L. Fortinberry, H. G. Fortinberry, E. R. Hawkins, A. B. Hayes, W. Ward Mohum, O. G. Moore, A. V. Owen and F. L. Seeley.

Fairbanks, Morse & Co., Chicago; water crane, tank fixtures, motor-driven displacement pump, centrifugal pumps. Diesel engines, platform and dial scales, scale beams, parts for motor cars, magneto, heavy and light section cars, patrol cars, electric motors, axle-lighting generators, turbine pumps, gas-driven generator set; L. T. Allis, W. F. Anderson, D. L. Arnold, E. P. Chase, R. V. Cook, E. J. Coverdale, J. F. Cruikshank, C. T. Fugitt, E. C. Golloday, W. R. Grant, H. L. Hilleary, E. F. Kultchar, R. F. Lane, D. K. Lee, C. G. Mahana, R. J. MacAtee, W. L. Nies, C. B. O'Neil, J. W. Prewitt, C. A. Rauch, H. E. Vogel, C. H. Wilson, William Yadon.

Fairmont Railway Motors, Inc., Fairmont, Minn.; gang cars, standard section cars, inspection cars, light section cars, inspection coaches, bridge and building cars, heavy duty cars, weed mower; Geo. Adams, C. P. Benning, C. W. Brhel, W. D. Brooks, K. K. Cavins, C. J. Dammann, W. G. Day, D. E. Doolittle, I. N. Eustis, A. R. Fletcher, C. F. Green, R. W. Jamison, C. H. Johnson, W. F. Kasper, J. T. McMahon, V. Pagett, R. W. Payne, H. W. Protzeller, W. H. Ripken, J. E. Simkins, H. A. Sly, H. M. Starrett, H. E. Wade, L. D. Whitaker, W. M. Williamson, F. C. Whitehouse.

Fansteel Metallurgical Corp., North Chicago, Ill.; rectifiers and transformers for signal service; R. B. Arnold, James Hall, C. G. Howard, Park B. Hyde, Allan Percy and Glen Ramsey.

General Electric Co., Schenectady, N. Y.; strain gage for impact tests for locomotives, tracks and bridges, gas engine driven arc welder, electric snow melters, motors and instruments, signal transformers, switch lighting transformers, lightning arrestors, capacitors and primary cutouts; C. C. Bailey, Lynn Covey, W. H. Coonley, C. Dorticos, W. G. Ferguson, R. F. Goggin, H. M. Jacobs, F. I. Kittredge, W. L. Margetts, R. B. McKinley, B. S. Pero, F. W. Peters, L. W. Shugg.

Goodrich Co., B. F., Akron, Ohio; rubber filler for expansion joints, railroad crossing slabs, composition bridge flooring, seating material, upholstery and decking material, Koroseal.

Hayes Track Appliance Co., Richmond, Ind.; bumping post, wheel stops, derails, derail operating stand; S. W. Hayes, H. J. Mayer and P. C. McClure.

Homelite Corp., Port Chester, N. Y.; portable generators, portable pumps, portable compressor and portable blower; R. J. Edbrooke and A. G. Straetz.

Hubbard & Co., Pittsburgh, Pa.; track tools, nut locks and spring washers; J. F. W. Kruse, L. J. Wenzel and John Wincrantz.

Industrial Brownhoist Corp., Bay City, Michigan; moving pictures of ballast cleaner, car dumper and locomotive crane; Thurman Frazee, Hoyt Hayes, A. P. Lyvers, Max Riebenack III, and C. H. White.

Ingersoll-Rand Co., New York; crawler-mounted compressor—4 tool, railway-mounted compressor, 4 tool, spot tamper, tie tampers, pneumatic tools, rock drills and mining tools, bridge and building tools, sump pump, concrete vibrator, impact wrench; W. H. Armstrong, G. E. Bridge, G. A. Gallinger, W. J. Heinz, R. H. Johnson, L. A. Luther, G. W. Morrow, K. I. Thompson, T. H. Weigand and D. W. Zimmerman.

Ingot Iron Railway Products Co., Middletown, Ohio; culverts, asbestos bonded paved pipe, multiplate pipe, perforated pipe, spiral welded pipe, metal crib wall, tunnel liner, portable air pipe, automatic drainage gates; R. Y. Barham, Edward C. Campbell, C. M. Colvin, E. T. Cross, William Crout, W. P. Greenawalt, W. J. Kelley, N. A. Powell, A. W. Spaulding, W. H. Spindler, J. R. Wilkes and J. L. Young.

International Harvester Co., Chicago; models of trucks and tractors, and photographs; R. C. Flodin, W. F. Hebard, J. W. Kalmes and A. W. Turner.

Johns-Manville Sales Corp., New York; transite conduit, roofing, transite pipe, transite smoke jack, asphalt mineral-surface bridge plank, fireproof-building materials, insulation, friction materials, refractories, asphalt tile flooring, soft mechanical packings; P. R. Austin, W. R. Bush, C. E. Bryant, C. S. Clingman, J. S. Doyle, J. D. Johnson, Thomas O'Leary, Jr., A. C. Pickett, H. R. Poulson, W. W. Prosser, R. P. Townsend, J. H. Trent, F. C. Vandervort and E. H. Wells.

O. F. Jordan Co., East Chicago, Ind.; model of Jordan spreader; A. W. Banton, J. C. Forbes, W. E. Kasten, H. M. McFarlane, W. J. Riley and C. W. Shipley.

Joyce-Cridland Co., Dayton, Ohio; track jacks, bridge jacks, journal jacks, car jacks, locomotive jacks, bus jacks; Mr. Ankeney, Huston Brown, J. P. Gentry, Kert Hott, E. A. Mann, R. E. Mann, B. C. McDonald, A. A. Walker, W. F. Weber and W. E. Webster.

Kalamazoo Railway Supply Co., Kalamazoo, Mich.; official inspection car, heavy and light-duty motor cars, pressed steel and wood center motor car wheels, track gages, level, section of gas engines; L. W. Bates, L. Boswell, R. E. Keller, F. E. McAllister, P. J. Robischung and K. B. Sylvester.

Kerite Insulated Wire & Cable Co., Inc., New York; insulated wire and cables; E. L. Adams, E. M. Branchfield, C. B. Brown, C. M. Deardorff, W. H. Fenley, J. A. Hamilton, H. J. Harrel, C. A. Reeb, J. A. Renton, J. Percy Robinson, A. H. Smith and J. Warren Young.

Lehon Co., Chicago; prepared roofing, asphalt shingles, asbestos shingles and roof coatings; John Eipper, R. J. Mulroney, J. W. Shoop and H. A. Wolfe.

Link Belt Co., Chicago; controls as applied to locomotive cranes, crawler shovels, draglines and cranes; H. F. Allen, J. C. Bloomfield, G. H. Olson, I. M. Pfau and L. P. Spillan.

Locomotive Finished Material Co., Atchison, Kan.; alloy steel self-guarded frog, model of cast iron crossing; R. L. McIntosh, A. H. Moorhead, H. E. Muchnic and G. W. Taylor.

Lufkin Rule Co., Saginaw, Mich.; measuring tapes, rules and precision tools, highway drag tape; R. M. Benjamin and T. P. Young.

Lundie Engineering Corp., New York; tie plates, rail and flange lubricator; L. B. Armstrong, C. E. Irwin, W. B. Joyce, D. H. Meyer and O. W. Youngquist.

Maintenance Equipment Co., Chicago; Meco rail and flange lubricator, switch-point protector, blue-flag derail, picture of three-man rail layers, samples of graphite base lubricants; S. E. Bates, D. M. Clarke, E. Overmier, T. E. Rodman, R. J. Shanahan and G. L. Springborn.

Mall Tool Co., Chicago; 5-hp. gasoline rail grinder, cross slotting attachment, nut-setting attachment, 16-hp. rail grinder, 8-hp. rail grinder, concrete vibrator with finishing attachments, rail drill, corrugation grinder; J. W. Innes, F. E. Kilbourn, A. W. Mall, F. McGonigle, M. Rehnquist and William Sanders.

Mars Signal Light Co., Chicago; grade crossing light; Mrs. Ethel V. Mars, Mrs. J. Kennelly, L. V. Walsh, J. Moeller, George Sanborn, R. J. Sheets and E. J. Walsh.

McKenna Process Co. of Illinois, Joliet, Ill.; tight-center, controlled-bearing and full-head contact joint bars; George Langford, George Langford, Jr., and Raymond A. Russel.

Metal & Thermit Corp., New York; pressure welding equipment for rail joints, pressure and compromise weld joints; C. M. Lippincott, Anton Lucas, Wm. Sharav, J. B. Tinnon, H. T. Thompson, L. G. Vock and C. D. Young.

Morden Frog & Crossing Works, Chicago; manganese insert frog, taper rail, compromise joint, adjustable rail brace, foot guard, switch accessories; E. C. Argust, R. A. Brown, W. Homer Hartz, G. F. Kilmer, Lyle Martin, C. E. Murphy and S. S. Withrow.

Morrison Railway Supply Corp., Buffalo, N. Y.; Osmose wood preservative, grinding wheels, welding rods, switch point guard, literature on welding service; G. J. Diver, R. L. Morrison, W. F. Pickham and E. Smith.

National Carbide Corp., New York; acetylene light and lantern, carbide flare light, motor car headlight; C. B. Armstrong and J. F. Callahan.

National Carbon Co., Inc., New York; dry cell batteries, flashlight cells, flashlight cases, high-voltage signal cells, anti-freeze and anti-rust compounds, air-cell batteries; D. H. Green, J. S. Gemmell, R. L. Hasbrook, F. C. Henderson, M. D. Rees and F. J. Wolfe.

National Lead Co., New York; metallic paint and allied products, expansion bolts; J. O. W. Belt, W. S. Carlisle, F. M. Hartley, Jr., F. W. Maynard, Hugh Millen, O. Meyer and A. H. Sabin.

National Lock Washer Co., Newark, N. J.; spring washers, ferrule wedge for tool handles; F. B. Archibald, George Goodell, W. R. Hillary, C. H. Loutrel, G. LaRue Masters, W. H. Reaves, S. H. Smith and G. E. Webster.

Geo. P. Nichols & Bros., Inc., Chicago; model of transfer tables, turn-

table tractors, driving trucks and roller bearings for turntables; B. Goldman, S. F. Nichols and G. M. Shearer.

Nordberg Manufacturing Co., Milwaukee, Wis.; surface grinder, utility grinder and accessories, lag-screw driver, track drill, adzing machine, power jack, spike puller, power track wrench, precision grinder; C. P. Clemmens, W. W. Fitzpatrick, C. K. Jensch and H. H. Talboys.

Okonite Co., Passaic, N. J.; insulated wires and cables, friction tape, rubber splicing compound, oil-o-static transmission system; R. N. Baker, A. L. McNeill, E. H. McNeill, J. J. O'Brien, J. D. Underhill, F. J. White and R. B. Zane.

Oxweld Railroad Service Co., Chicago; welding equipment, samples of welded rail, switch points and pipe, compromise joints, samples of Stellite in track equipment, flood lights, heat-treated joint; Lem Adams, M. C. Beymer, C. A. Bloom, G. P. Bogert, M. Burnett, Jr., W. E. Campbell, E. Cordeal, W. E. Donalds, F. J. Duffie, C. J. Gavin, E. B. Hall, Jr., F. C. Hasse, W. A. Hogan, H. W. Kofmehl, R. G. Kohn, J. W. Lacey, William Leighton, G. B. Moynahan, D. H. Pittman, E. S. Richardson, J. H. Rodger, L. C. Ryan, H. W. Schulze, J. C. Stephenson, F. C. Teichen, and J. E. Winslow.

P & M Company, Chicago; rail anti-creeper, bond wire protector, tie plates; S. M. Clancey, W. G. Cunningham, John J. Gallagher, D. T. Hallberg, P. H. Hamilton, G. E. Johnson, J. E. Mahoney, W. A. Maxwell, G. E. Olson, R. W. Payne, W. H. Reaves, M. K. Ruppert, F. S. Schwinn, Jr., L. S. Walker, G. E. Webster, and G. T. Willard.

Parker-Kalon Corp., New York; self tapping screws; S. S. Kahn and Roland Roe.

Pettibone Mulliken Co., Chicago; high switch stands, switch-point lock, model and full-size crossing, gage plate, mechanical switch; J. H. Asselin, W. F. Brietzke, J. B. Campbell, A. R. Hearle, C. A. Johnson, C. A. Lanberg, George Lyman, and G. J. Slibeck.

Pocket List of Railroad Officials, New York; copies of publication; Harold A. Brown and B. J. Wilson.

Power Ballaster Co., Chicago; working model of power cribbing machine motion pictures; H. K. Christy, V. Coble, Robert Mattison, Hobart Newman and F. H. Philbrick.

O & C Co., New York; switch-point guard, derail, gaging tool, gage rods, rolled steel compromise joints, alloy steel compromise joints, guard rail clamp, safety rail tongs, electric snow melter; G. H. Goodel, L. E. Hassman, E. I. Hetsch, F. L. Kemper, J. L. Terry, Lewis Thomas and C. H. Wilson.

Rail Joint Co., New York; standard and insulated joints, controlled or intermittent bearing joint, armored insulated joint, alloy compromise joints, tight center joint; W. J. Acker, V. C. Armstrong, E. W. Backes, Alex Chapman, G. M. Clodfelter, E. A. Condit, W. E. Gadd, H. C. Hickey, G. H. Larson, J. N. Meade, J. G. Miller, R. W. Payne, Thos. Ryan and E. F. Schermerhorn.

Railroad Accessories Corp., New York; power track machines for tightening and loosening nuts and setting screw spikes, moving pictures of track machines in use, tie borer, hand bonding drill and power bonding drill, S. G. Ellis, F. C. Lavarack, B. A. Lundy and F. F. Seeburger.

Rails Co., New Haven, Conn.; tie plate and rail fastener, screw spikes, cut spikes, oil, electric and gas snow melters, rail, flange and curve lubricator, crossing flange-way bracket; L. T. Burwell, G. M. Hogan, Milburn Moore, E. R. Packer and R. J. Platt.

Railway Age-Railway Engineering and Maintenance, New York; copies of publications; G. E. Boyd, M. H. Dick, J. H. Dunn, S. O. Dunn, F. J. Fisher, L. R. Gurley, S. W. Hickey, N. D. Howard, E. T. Howson, F. C. Koch, W. S. Lacher, Henry Lee, J. G. Little, H. E. McCandless, H. H. Melville, H. A. Morrison, E. J. Phillips and L. B. Sherman.

Railway Maintenance Corporation, Pittsburgh, Pa.; rail joint packer, rail joint corrosion inhibitive, mole derrick, conveyor belt, conveyor flights for mole; W. M. Bell, J. F. Casey, Jr., J. B. Williams.

Railway Purchases and Stores, Chicago; copies of publications; J. P. Murphy, Jr., and K. F. Sheeran.

Railway Track-Work Co., Philadelphia, Pa.; portable reciprocating track grinder, portable stock-rail grinder, electric track grinder, rail-joint cross grinder, portable track grinder, samples of abrasives, literature; C. L. Sherman and A. M. Nardini.

Ramapo Ajax Corp., New York; safety switch stands, rigid switch stands, rail lubricator, selective process heat treated rail, metal highway crossing, gage plate; T. E. Akers, G. A. Carlson, G. M. Cooper, J. E. Davidson, R. E. Einstein, R. M. Evans, H. Hazelton, A. F. Hess, D. F. Hilton, P. Hoffman, A. F. Huber, J. S. Hutchins, R. P. McClave, J. A. McVicker, R. W. Payne, W. A. Peddle, W. Perdue, H. W. Renick and J. B. Spencer.

S. E. Rawls Co., Streator, Ill.; track mower, motor scythe; C. F. Butts, E. J. Jaeger, L. C. Meskimer, Mertz Rawls and S. E. Rawls.

Renchtite Spring Nut Co., Chicago; spring nut, cut-off machine; W. A. Bergstrom, H. O. Erickson, W. M. Johnston and S. C. Morse.

Republic Steel Co., Cleveland, Ohio; track bolts, track spikes, tie plates, guard rail, fencing and barbed wire, steel fence posts, culverts, sectional plate, nails and staples, iron sheets, iron pipe, bolts and nuts, turn-buckles, inter-track slabs; C. H. Aiken, R. W. Baker, R. A. Bell, J. B. Beyer, F. W. Bleiler, A. J. Brandt, A. E. Brown, George Butler, T. B. Davies, L. W. Fletcher, J. R. Fraine, N. W. Halls, B. F. Handloser, W. E. Lambert, W. B. Long, A. D. McAdam, H. L. Miller, C. F. Newpher, W. T. O'Neill, A. J. Roof, Frank Schumacher and L. L. Solger.

Schramm, Inc., West Chester, Pa.; air compressor; G. S. Boers, George B. Comfort and Allan Maland.

Sellers Manufacturing Co., Chicago; wrought iron tie plate, universal tie plate, angle bars rolled from steel axles; J. T. Flynn, W. L. Helliwell, G. M. Hogan, A. F. McCoole, R. J. Platt, S. H. Smith and R. A. Van Houten.

Sika, Inc., New York; water-proofing material; Paul Kohler and Hugo Zichner.

Snap-On Tools, Inc., Kenosha, Wis.; socket wrenches, power tools; J. E. Robertson.

Syntron Co., Pittsburgh, Pa.; electric tie-tamper, cross sections of electric tie tampers, tie tamper scaling hammer, timber saw, electric drill; D. G. Black, J. F. Chandler and J. A. Roach.

Teleweld, Inc., Chicago; joint shim, samples of welded joints, heat-treated joints, bridge welding sample, Brinnel-hardness tester; R. E. Bell, T. L. Borman, G. A. Greene, John E. Hogan, C. W. McKee, H. E. McKee, W. A. Peck, J. A. Roache and Stanley H. Smith.

Templeton, Kenly & Co., Ltd., Chicago; rail pullers and expanders, tie spacer, track jacks, push and pull jacks, bridge jacks, ball bearing screw jacks; E. D. Carthey, William Cornu, H. C. Dilsizian, R. B. Hill, P. H. McManus, Charles Neher, William Simpson and J. B. Templeton.

Thompson & Co., Pittsburgh, Pa.; process for protecting metal; J. L. Crowley, Otis E. Hovey and D. D. Munroe.

Timber Engineering Co., Washington, D. C.; timber connectors and installation tools, split rings, toothed rings, toothed or flanged shear plates, spiked grids and clamping plates for bridge and building construction; Ira D. S. Kelly.

U. S. Gypsum Co., Chicago; gypsum plaster and plaster products, steel products, asbestos and magnesia products, gypsum wall board, insulation board, mineral wool and blankets, asphalt roofing products, built-up roofing, chemical hydrated lime, expanded metal products, pipe covering, paint products, lathing materials, sawed insulation, acoustical products and treatment, metal roof decks, gypsum roof decks poured and precast, gypsum partition tile; W. J. Berry, J. J. O'Hara, John C. Stewart and J. L. Vonerk.

United States Steel Corporation Subsidiaries:
American Bridge Co., Pittsburgh, Pa.; photographs.
American Steel & Wire Company, Chicago; wire rope, fence, rail bonds, posts and S-irons; H. R. Barthel, C. A. Cochrane, H. H. Febrey, A. W. Froude, C. W. Mathews, A. J. McKernan and L. P. Shanahan.
Carnegie-Illinois Steel Corporation, Pittsburgh, Pa.; normalized rails GEO and misc. fittings, I-Beam-Lok bearing pile, reinforcing bars, high tensile steels, photographs stainless steel trains and high tensile trains, culvert sheets and plates, frogs and switches; J. H. Ainsworth, O. H. Baker, Fred Bendell, D. V. Carlson, J. J. Davis, Jr., J. C. Dilworth, C. B. Friday, S. L. Graham, F. C. Hardie, E. E. Hedberg, N. M. Hench, J. H. Hornbrook, Robert Korsan, Jr., John A. Reed, T. H. Sanderson, W. G. Somes, H. K. Troxwell and L. P. Worthington, Lorain division; Carroll Burton, G. R. Bossler, T. W. Brush, S. J. Cotsworth, M. J. Kist, H. H. McDonald, J. A. McHugh, R. B. Porter, M. L. Rahner and H. C. Stiff.
Cyclone Fence Company, Waukegan, Ill.; chain link fence, steel picket fence.
National Tube Company, Pittsburgh, Pa.; tubular products; J. J. Kennedy, Jr., B. H. Rickard.
Scully Steel Products Company, St. Louis, Mo.; A. W. Johnson, A. G. Nelson, H. A. Parkin, W. Schuett, L. H. Schwan and E. C. Vallette.
Tennessee Coal, Iron & Railroad Co., Birmingham, Ala.; Geo. Bruner, C. U. Cook and R. H. Ledbetter.
Universal Atlas Cement Company, Chicago; M. A. Berns, A. C. Cronkrite, E. J. Dowdall, O. H. D. Rehwen, F. L. Stone and C. C. Webb.

U. S. Wind Engine & Pump Co., Batavia, Ill.; water-column, valves, switch stands, semaphore switch stands, float valves, models of water tanks and towers; H. Beem, R. C. Carlson, J. P. Prindle, E. Schumacher, LeB. Turner and C. E. Ward.

Western Railroad Supply Co., Chicago; inductor contact, flashlight crossing signals, wigwag signals, revolving-banner signals, crossing bells, semaphore lamps, gate lamps, switch lamps, motor car spotlight, reflectorized signs, lightning arresters, annunciators, electric meters, signal accessories, dragging-equipment detectors; H. M. Buck, T. H. Cole, F. M. Dolan, L. V. Dolan, Godfrey Gort, Norman Gort, John Hensel, F. M. Hill, S. Miskelly, Stanley H. Smith and W. O. Swonger.

Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.; welder-capacitor, cutout lightning arrester, rectifiers for battery charging, floodlights, transformer, electric meter display; C. A. Bercaw, W. G. Books, P. H. Grunnagle, S. F. Johnson, R. H. Kilner, H. L. Martin, T. W. Merrill, C. L. Neill, W. F. Smith, L. A. Spangler and T. C. Wurtz.

Woodings-Verona Tool Works, Verona, Pa.; spring clip tie plate, triflex spring, bent shoulder tie plate, rail anchor, safety claw bar; J. M. Burbank, A. C. Laesig, James McComb, R. J. McComb, G. L. McKewin, E. Woodings and W. H. Woodings.

Woolery Machine Co., Minneapolis, Minn.; light-weight motor car, display of weed burner photographs, power tie cutting machine; O. B. Follette, A. J. Franke, H. E. Woolery and W. F. Woolery.

Yale & Towne Mfg. Co., Chicago; chain hoists, I-beam trolleys, pull-lifts, hand lift truck, crane trucks, photographs of crane trucks, motion picture of material handling; R. J. Arehart, R. L. Biang, S. W. Gibb, J. R. Harlan, G. C. Hayes, Ralph Irwin, G. C. Isbester, S. A. March, F. E. Milner, C. H. Moeller, C. E. Schindler and G. Tipton.

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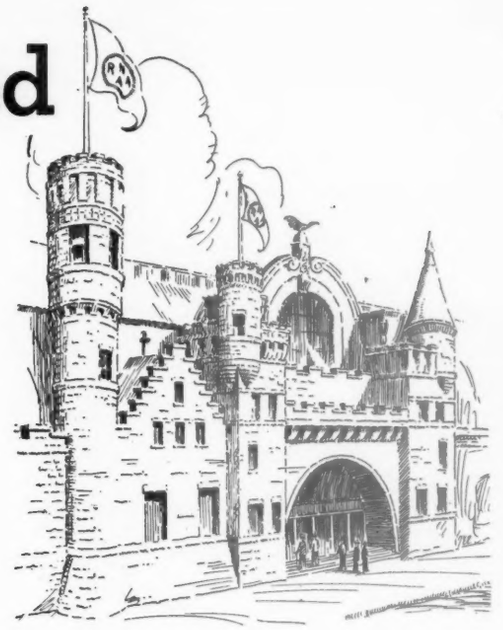


Small Party Inspection Coach

COMFORT, safety and ease of operation are said to feature the new "Fairmont 1100" inspection coach which has just been placed on the market by Fairmont Railway Motors, Inc., Fairmont, Minn. This coach, which was designed for small inspection parties, will accommodate five passengers and a driver, with ample space for moving about. The seats, which are cushioned in leather, have been arranged particularly to provide a clear and unobstructed view for all members of the inspection party. All seats, except that for the secretary, are reversible, giving equal visibility when running backward. Through a special arrangement of the driver's seat, the instrument panel and the controls, it is almost equally convenient to drive forward or backward.

The Fairmont 1100 Inspection Coach

Power vacuum brakes insure quick stopping. As a further safety measure, vacuum adjustment of the shoe pressure can be made to prevent the sliding of the wheels when the rail is wet or covered with snow or sleet. The four doors with which the coach is provided tend to swing forward when the brakes are applied. This is designed to prevent passengers from being knocked down if they step off the coach while it is in motion. Grab irons and low steps add to safety when getting on or off.

The overall length, width and height are 11 ft. 5¾ in., 7 ft., and 7 ft. 4½ in., respectively, and the wheel base is 66 in. Equipped with seating for five passengers the coach weighs 4,170 lb. The engine is an 80-hp., Ford V-8, with rubber mounting, the chassis and engine being identical with the A6 series B gang car manufactured by this company. Both floor and engine housing are carefully insulated against temperature, noise and odors. The doors and windows are of the automobile type, and the headlights, which are streamlined into the front and rear ends, are the 1936 Ford design. Ignition and lighting current are obtained from a 17-plate, 93 a.h. plate-locked battery. Two combination dome lights and ventilators are located in the roof, and four electric marker lights can be furnished if desired. An electric windshield wiper and fan are located at each end of the coach and wiring is in place for an electric heater which can also be provided if specified.

The instrument panel contains an a-c. speedometer, an ammeter, gages for oil pressure, fuel tank and water temperature. The starter, horn buttons, choke, ignition, panel light switches, vacuum regulator, brake valve and throttle quadrant are also on the panel. In normal driving the driver handles the controls as in an automobile; when backing up he can turn sidewise to look forward or backward, and yet be in reach of all controls.

Make Weld Test on Nickel-Manganese Frogs

ONE of the more recent developments in trackwork is the use of nickel-manganese steel in turnout frogs. It has been claimed that the introduction of nickel permits a reduction in the carbon content while retaining the austenitic structure of the metal that is the source of the valuable properties of managanese steel. It is said also that, by reason of the lower carbon content, there is far less likelihood of a change in the structure of the metal (carbide formation) as a result of the application of heat in welding, and that for that reason nickel-manganese frogs can be welded readily, even with the gas flame, without danger of developing brittleness.

To check these claims for nickel manganese steel, two frogs in a heavy-traffic lead track in the Galewood (Chi-

cago) yard of the Chicago, Milwaukee, St. Paul & Pacific were recently subjected to maintenance welding—one by the electric arc and the other with the oxy-acetylene flame.

The frogs were made by the Pettibone-Mulliken Company, Chicago, and exhibited the following chemical and physical properties:

Chemical Analysis

Carbon	0.60- 0.90
Manganese	11.00-13.50
Nickel	2.5 - 3.5
Silicon	0.60- 0.85

Physical Properties

Tensile strength	155,500 lb. per sq. in.
Yield point	60,000 lb. per sq. in.
Elongation in 2 in.	55 per cent
Reduction in area	36.6 per cent
Brinell hardness number	196

The gas welding was done substantially in accordance with practice followed in welding open hearth carbon steel, and in the arc welding no effort was made to avoid excessive heating of the parent metal by "skipping about" as is commonly done when welding on ordinary high manganese steel. Peening was done while the weld was hot. Stultz-Sickles nickel-manganese steel electrodes were used for both the arc-welding and the gas-welding.

Nickel-Manganese Steel Frog 60 Days After Welding

These two frogs had been in service about two years when the welding was done and in the four months that have since elapsed there have been no cracks or breaks that would indicate that the metal had been injured by heating while the welding was being done.

T-20 Tractors Do Variety of Work

AMONG the five designs of track-type tractors built by the International Harvester Company, Chicago, the T-20 model is adapted especially for railway work. This tractor, equipped with a bulldozer, can be employed for cleaning out cuts, while the illustration shows its use in widening banks with a Baker bulldozer. In this instance two men, one the operator and the other engaged in leveling off the shoulder, widened 400 to 600 ft. of embankment a day. Although the excavation was made close to the embankment, the photograph shows no uneven gouging, the right of way being left smooth and without impairing its drainage. Since off-track equipment of this type does not interfere with the operation of trains and is itself unaffected by the movement of traffic, there was no dead time for clearing trains and no cost for train crews or flagging.

The T-20 tractor is also adapted for other classes of railway work when equipped with other devices and attachments, including the mowing of the right of way, cleaning snow from platforms and driveways, ditching, grading, operating winches, hoist, etc. Tractors of this type were used in stringing and tightening the wires on the Pennsylvania electrification between Philadelphia, Pa., and Washington, D. C. As it is only 55½ in. wide and can be turned in a circle having a 6-ft. radius, it can be worked in restricted quarters.

Widening Shoulder with a T-20 Tractor

Scale for Freight and Warehouse Service

AN ENTIRELY new design of self-contained or dormant floor scale for freight houses and warehouses has been developed by Fairbanks, Morse & Co., Chicago, to meet today's requirements for handling freight and materials with heavy trucks. This scale, which conforms to the requirements of the latest A.R.E.A. specifications, is built so that each corner of the platform will carry 50 per cent and each end will carry 100 per cent of the total rated capacity of the scale. Levers are supported on stands at each corner and are fitted with removable, inter-changeable, machined pivots. The platform is suspended from the main-load knife edge by Fairbanks Type S single-bolt suspension, which permits platform movements without disturbing levers or bearings at the point of contact with knife edges. Platform overhand outside of the points of support, at

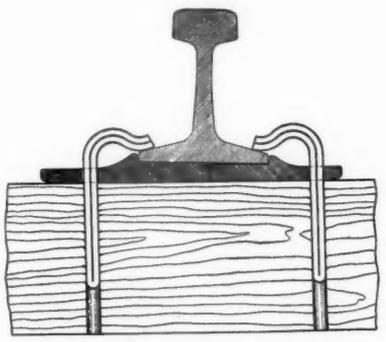
New Floor Scale for Heavy Service

both ends and sides, has been reduced to the minimum with the view to eliminating tipping when loads are trucked onto the scale.

This type of scale can be furnished in an all-steel box with steel platform; in a wood box with steel platform for installation in the floor; or with a skeleton frame and steel platform for installation in a concrete pit. It can be equipped with either automatic dial or standard beam.

Elastic Rail Spike

A SPRING-TYPE track spike that is driven to a contact with the flange of the rail in much the same manner as the ordinary cut track spike but possessing characteristics which tend to produce a stiffer, yet yielding, track structure, is now being introduced,



Sketch Section Showing the Application of the Elastic Spike in Otherwise Ordinary Track Construction

after having been tested successfully in Europe for a period of about three years and more recently in this country. The new spike, which is known as the Elastic rail spike, is made of 5/8-in. by 5/16-in. heat-treated spring steel stock, doubled back on itself. It has a straight shank which is driven into the tie, and a goose-neck top or head, which extends over to a spring tension bearing on the rail base. The spike is 5/8 in. square in section, and at the present time is being made 7 3/8 in. long.

The new spike is adapted to present standard track construction with double shoulder tie plates, except that it cails for special punching of the plates, with the center lines of the holes set back 1 3/16 to 2 1/4 in. from the inner faces of the plate shoulders, and also for the boring of the ties either before treatment or in the field. The spike is readily driven into the bored hole with an ordinary spike maul, the pressure exerted on the rail base being governed by the depth to which the spike is driven after the forward part of its head makes contact with the rail. Usually, this additional depth should be approximately 1/4 in., which produces a pressure of 700 to 1,000 lb. on the rail.

The features claimed for the spike are that it ties the track structure together tightly at each tie, minimizing the movement between the rail and the tie plate and between the tie plate and the tie, and thereby reducing noise and mechanical wear; that it has a tendency to stiffen the entire track structure, reducing wave motion in the track and increasing the distribution of the wheel loads; that it effectively eliminates rail creepage; and that it maintains a desirable degree of resiliency in the track structure as a whole.

It is claimed that through the special shape and yielding character of the spike head, practically all vertical force on the spike at the rail base, due to vertical movement of the rail under traffic, reacts laterally at the shank of the spike. This effect, combined with the normal high holding power of the square spike driven in the proper size round hole in the tie, practically assures that the spikes will not back out under traffic. As a matter of fact, both prolonged service and laboratory tests appear to confirm this fact.

A pull exerted vertically at the shank of the spike is required to withdraw it from the tie. This can be effected with a claw bar, but is done more effectively with specially designed jaw-type pullers, which grip the shank and produce the necessary vertical lift. The spike may be redriven repeatedly, if necessary, with no appreciable effect upon its holding power. The Elastic rail spikes are being manufactured by the Elastic Rail Spike Corporation, an affiliate of Bernuth, Lembcke Co., Inc., New York.

One of the Several Sizeable Test Installations of the Elastic Rail Spike Made in the United States During 1936

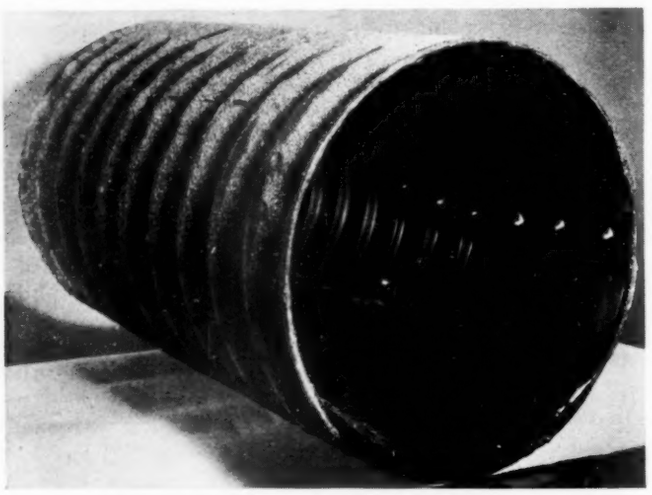
Armco Asbestos Bonded Paved Pipe

THE Armco Culvert Manufacturers Association, Middletown, Ohio, has introduced an improved type of corrugated paved invert pipe, known as asbestos bonded paved invert pipe, which, while developed to resist severe corrosive conditions, is also recommended for use wherever a high degree of permanence is desirable. In the new product the bituminous paving in the pipe is bonded to the metal by means of asbestos fibers which are embedded in the zinc coating of the pipe while it is hot. This is done by forcing a layer of asbestos felt under a pressure of several thousand pounds into the flat sheet of iron as it emerges from the galvanizing rolls. The porous mass of asbestos fibers remaining on the metal following this operation are then saturated with a special bituminous material or primer which provides a bond between the fibers and the bituminous paving.

Bituminous paving applied to corrugated pipe inverts in this manner is claimed to offer a high degree of resistance to the various deteriorating influences to which such pipe is subjected in actual service. Various tests that have been conducted on this pipe are said to have served to substantiate this contention. For instance, to prove the ability of the bituminous paving to resist shock in cold weather, a coated half-section of asbestos bonded pipe was cooled to 0 deg. F., after which a steel ball

weighing 1.67 lb. was dropped on the frozen sample from a height of 7½ ft. without causing spalling or cracking of the bituminous material. As a further test, a specimen of the pipe was placed upright in an electric furnace and left in that position for four hours at a temperature of 180 deg. F. At the end of this period the pavement had "flowed" less than ¼ in.

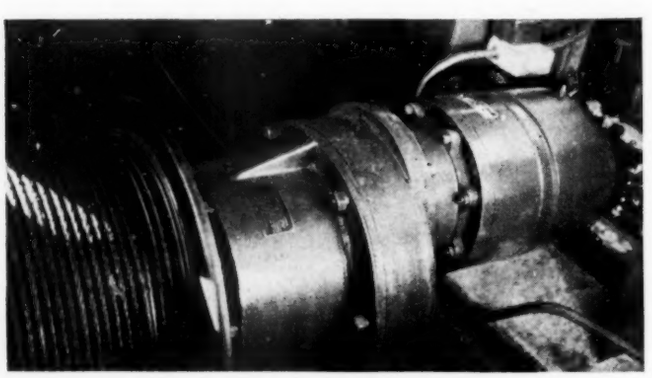
Other advantages claimed for the new type of bonding are that it widens the plastic range of the bituminous material as much as 52 per cent, that the asbestos fibers produce a cushioning effect which absorbs the pressure caused by water freezing in the pipe, and that, being a non-conductor of heat, the asbestos layer helps to maintain a perfect bond between the coating and the metal in spite of the difference in expansion between the two materials.



A Section of Asbestos Bonded Paved Invert Pipe

New Automatic Coaling-Station Hoist

ROSS and White Company, Chicago, has placed in service a new design of automatic reversible hoist for skip buckets in locomotive coaling stations. This new hoist is of the totally enclosed, oil-bath design, using the heliocentric reducing principle which is manufactured by the Universal Gear Corporation, Indianapolis, Ind. The motor, brake, reducer and hoist drum are mounted on a single base in a straight line. The speed of the motor is normally 1,800 r.p.m. and is reduced through the heliocentric gear to a drum speed of about 15 r.p.m. The new hoist has the advantage of unusual compactness, for which reason it is said to require less room than other available types. It is also said that the unique principle involved in the heliocentric gear tends to low maintenance costs and high efficiency. The accompanying illustration is of a recent installation, in which a General Electric, totally enclosed, fan-cooled, ball-bearing, squirrel-cage motor was used as the power unit.



Heliocentric Gear Reduces Speed

Kinnear Develops Steel Rolling Door

THE Kinnear Manufacturing Company, Columbus, Ohio, has developed a manually-operated sectional upward-acting door, known as the all-steel Rol-Top door, for use in warehouses, freight houses, and other locations where such doors are applicable. The new door consists of sections of copper-bearing steel galvanized by the hot process, each of which is interlocked with adjacent sections along both the top and bottom edges in such a manner that each interlocking forms a continuous hinge. The interlocking edges of each section also act as reinforcing members.

In This Kinnear All-Steel Rol-Top Door the Three Lower Sections Have Been Left Down to Act as a Barrier

Rollers at the end of each hinge operate on a steel track attached to the door jamb, which extends the full height of the door and carries a horizontal leg to accommodate the door in the raised position, the two legs of the track being connected by a section of curved track. The rollers are of a specially-designed, heavy-duty, self-alining type and are equipped with ball bearings. They have a one-piece, solid steel tread operating around a hardened steel race and sleeve, and are said to float freely on shouldered pins which lock the door securely in the track and yet allow the free movement that is necessary for maximum ease of operation. The door is counterbalanced by means of springs which are connected to each side of the door by a preformed cable

running through ball-bearing sheaves. These cables are said to provide a uniform pull on both sides of the door so that there are no "dead" points or places of difficult operation. The bottom of the door is fitted with a rubber weatherstrip, while at the top an adjustable weatherstrip is provided which allows for any slight variation in the height of the opening.

A feature of the door is that the lower two or three sections can be disconnected from the remainder of the door and allowed to remain in the opening, serving as a barrier, while the rest of the door is in the raised position. This arrangement has been found useful in locations where the heat makes it necessary to keep the doors open for ventilation purposes and where, at the same time, it is desirable to have barriers in the door openings.

A Shovel-Barrow

THE Shovel-Barrow Company, Chicago, has introduced into this country an ingenious type of trucking barrow, which not only carries its load, well balanced, entirely on a pair of wheels, without lifting effort on the part of the operator, but which also scoops its load and readily discharges it. The new barrow, which

The Shovel-Barrow Scoops Its Own Load and Then Carries It Balanced Over the Wheels

is known as the Shovel-Barrow, consists essentially of a scoop-shaped pan or tray, with a capacity of approximately four cubic feet; a load-carrying axle with two 14-in. steel wheels; a push bar and a pair of loading handles, suitably trussed to the scoop; and a pan-lifting and pivoting foot treadle, which assists in both the loading and dumping action.

The pan, with flared sides and back, is approximately four feet long, and is constructed of 18-gage steel with a heavily reinforced cutting edge. The rear of the pan rests in an unattached position upon the carrying axle, the wheels of which have two-inch treads mounted on roller bearings in dust-proof housings. If desired the wheels may be equipped with solid rubber or pneumatic tires.

The push bar, which is located at about arm's length below the operator's shoulders when the load is balanced, is the normal means of pushing or pulling a load. The scoop handles, on the other hand, normally below this level when a load is balanced, come to about this level when the front edge of the pan is dropped to the floor in scooping position. So located, they form a means whereby the scooping edge of the pan can be forced into any piled material subject to scooping.

The foot treadle arrangement is essentially a steel frame which pivots above the wheels, extends around the rear of the pan, and gives support at its front end to the bottom of the pan immediately ahead of the position of the center of gravity of the normal load. When the rear of the treadle is pressed down by the foot of the operator, the pan as a whole, with its load, is raised vertically, clear of the chassis, the full weight of the load coming upon the forward bar of the treadle arrangement, about which the pan can be rotated forward by lifting the handles, to discharge the load.

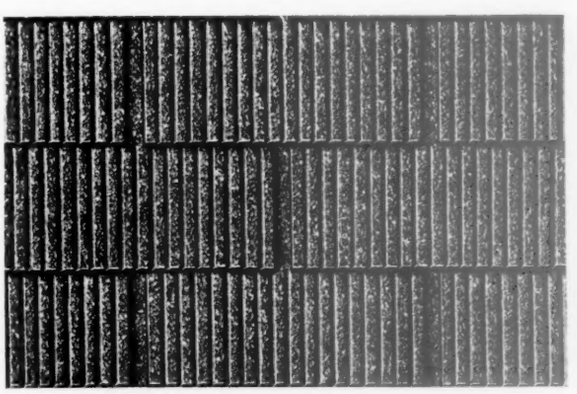
To secure a full load in the barrow requires two thrusts into the material being loaded. After the first thrust, slight downward pressure on the foot treadle and, at the same time, on the handles or push bar, throws the loaded material back into the rear of the pan. A second thrust then reloads the forward part of the pan, producing a full, well-balanced load.

It is said that the shovel-barrow is effective and saves time in the handling of such material as cinders, coal, sand, gravel and debris, and that it should be particularly effective in the removal of uncompacted snow from station or shop platforms and driveways. Its particular advantage is, of course, its self-loading feature, although where used in transporting materials not subject to self loading, it has the advantage over the ordinary wheelbarrow of relieving the operator of any of the load.

A New Asphalt Shingle

A NEW line of asphalt shingles is being placed on the market, under the designation of Cor-du-roy, by the Lehon Company, Chicago. These shingles are made in square-tab and hexagonal strips and Big Maud shape, the general outline and weight being similar to the corresponding shapes in smooth-surface shingles, from which they differ principally in surface texture. Instead of the usual flat, smooth slate surface, the new shingles have corrugations which are designed to break up the flat monotony of the present designs. It is said that these corrugations, which are introduced by means of corrugating rolls through which the roofing passes while the asphalt is still warm and plastic immediately after the asphalt coating and slate surfacing are completed, do not disturb the felt base, and that there is as much or more asphalt coating on the felt as on the heavier grades of roll roofings.

A considerable number of roofs laid with an older

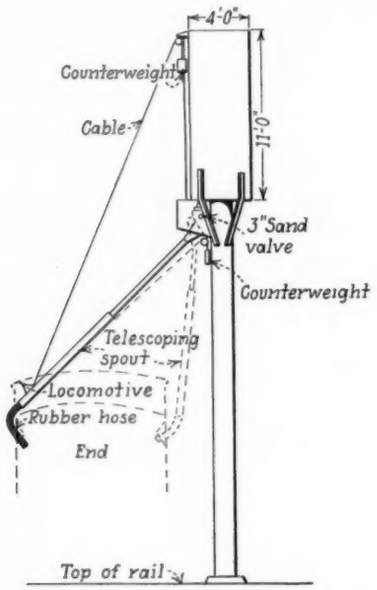


Cor-du-roy Shingles Break Monotony of Flat Surface

design of these shingles have been in service for several years, and it is said that they have retained their original color and appearance and have been free from leakage, curling and blowing up, because of the resistance afforded by the corrugations. It is said also that the corrugations tend to absorb contraction and expansion, thus eliminating surface checking and cracking, which so often affect smooth-surface roofing, and enabling the shingles to retain the slate surfacing intact. It has been found on the roofs laid with these shingles that the corrugations tend to give quicker drainage because the channels collect and guide the water down the roof, and by thus preventing side flow, keep it from blowing under the shingles or settling in or around nail holes.

Sanding Facilities for Diesel Locomotives

A NEW design of sand storage and delivery has been installed at Boston, Mass., for the New York, New Haven & Hartford, by Ross and White Company, Chicago, for delivering sand to Diesel locomotives. The standard sand valves and spouts used heretofore for delivering sand to steam locomotives were not adapted



Sanding Plant for Diesel Locomotives

for use with the Diesel locomotives, since the latter have four sand boxes, one at each corner of the housing, with the openings for receiving the sand slightly below the roof in the sides of the housing.

The dry-sand service storage consists of a circular steel bin 4 ft. in diameter by 11 ft. high, supported on a 16-in. tubular column. The new valve is arranged to be opened by an operating lever, to the end of which is attached a cord which passes over a sheave and leads to a loop welded to the lower end of the delivery pipe, to which it is fastened. This loop also serves as the attachment for the upper end of the pull-down rope.

A 2½-in. telescoping boiler-tube pipe which can be lengthened or shortened as required, serves as the delivery pipe. Its upper end is pivoted about the sand valve, so that it can be changed from one side of the locomotive to the other. The lower end is fitted with reinforced flexible hose, thus enabling the hostler to deposit sand in the boxes on either side of the locomotive. Counter-weights are arranged to provide ease of operation when raising, lowering, extending or telescoping the sand spout.

A Hook Bolt That Does Not Turn

THE Sealtite bolt, manufactured by the Lewis Bolt & Nut Company, Minneapolis, Minn., is designed for use on timber trestles and open-deck steel bridges. It is fitted with four forged fins below the shoulder of the hook, which are designed to offer positive resistance to turning. It is said that this bolt can

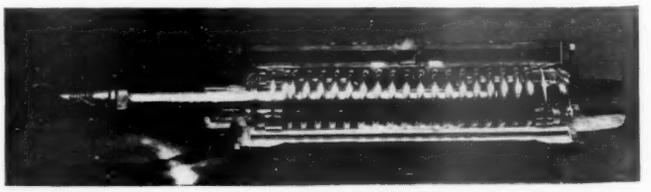
Fins Near Hook Prevent Turning

be driven into holes of the same diameter without splitting the wood. Sealtite hook bolts and nuts are threaded and tapped with the Dardelet self-locking thread, thus affording protection against loosening as a result of vibration.

Pettibone Mulliken Improves Spring Switch

THE Pettibone Mulliken Company, Chicago, has incorporated a number of improvements in its mechanical switchman (spring switch). Known as the Model B mechanical switchman, the improved spring switch differs from its predecessor in that the operating parts, such as the piston rod, pistons, valves and springs, all of which are interchangeable with those in the old model, are housed in a sleeve that is contained within a housing or casing, with an oil space entirely surrounding the sleeve.

As heretofore the oil intake is in the top of the housing but when the oil is poured in it flows over the sleeve to



Cut-Away View of the Model B Mechanical Switchman Showing the Arrangement of the Operating Parts in an Inner Sleeve

the bottom of the housing, from which place it gradually gains entrance to the inner sleeve through holes in the bottom of that piece. By causing the oil to flow to the bottom of the housing before entering the inner sleeve, assurance is given that any foreign substance heavier than oil that may be contained in the lubricant will settle to the bottom of the housing and will not gain entrance to the sleeve. Moreover, any water or other foreign substance heavier than the oil that may get into the sleeve

will drop through the holes to the bottom of the housing where it will not interfere with the operation of the mechanism.

When this device is in operation a certain amount of oil is displaced, and two holes are provided in the top of the inner sleeve to allow this oil to escape into the air pocket at the top of the housing. These holes are placed a sufficient distance from the oil intake hole to insure that oil will not flow directly through them into the sleeve. The Model B switchman will hold 13 pints of oil and each unit that leaves the plant is filled with an oil that is especially adapted to this purpose.

Like its predecessor, the new model is double acting, that is, trailing movements are permitted from either track without disturbing any of the parts, and it may be thrown manually without spring compression resistance. The improved device also retains the two-speed return movement feature. With this feature the first half of the return movement of the switch points is made at a slow speed and requires about 10 or 12 sec., the purpose being to prevent excessive wear of the switch points by restricting the return movement between trucks to a minimum. The last half of the return movement is made at a faster speed, requiring less than a second, at the end of which the switch point is forced tightly against the stock rail.

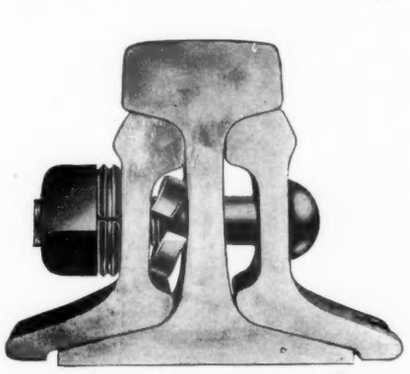
New High Pressure Spring Washer

THE Eaton Manufacturing Company, Reliance Spring Washer division, Massillon, Ohio, has introduced a new spring washer for track joint use, known as the Hy-Pressure Hy-Crome spring washer,

The Hy-Pressure, Hy-Crome Spring Washer

which is offered as complying with requirements of the specifications of the American Railway Engineering Association. This washer is said to possess features superior to this company's AREActive Hy-Crome washer. As shown in the large scale view of this washer, it has a well-defined groove in the outer edge which has been introduced for ready identification in the track.

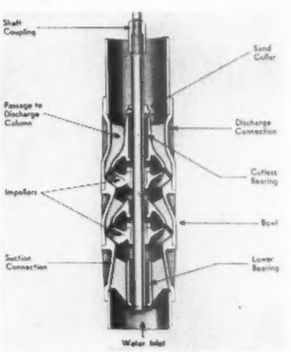
This new washer is shown also between the back of the nut and the face of the joint bar in the cross-section of a rail joint assembly. This view also illustrates the application to a rail joint of the Hy-Crome bonding spring, also manufactured by the Eaton Manufacturing Company. As is seen, the bonding spring is introduced on the bolts between the web of the rail and the inside face of the angle bar.



The Hy-Pressure Washer and the Bonding Spring in a Rail Joint Assembly

New Designs in Turbine Pumps

FAIRBANKS, Morse & Co., Chicago, has improved the design of its line of deep-well turbine pumps, as well as the added two new combination units for general use. The open-impeller, rubber-bearing



New Design of Open Impeller

pump, designated as Fig. 6950, is particularly suitable for wells in sandy strata, or for pumping water containing sand or silt from sumps. The design of this turbine is shown in the accompanying illustration. A new open type of impeller having metallic bearings has also been developed for use with pump bowls designated as Fig. 6920. In both cases, the open impeller feature allows the rotating assembly to be adjusted in the pump bowls so that the amount of water delivered may be varied without any change of equipment.

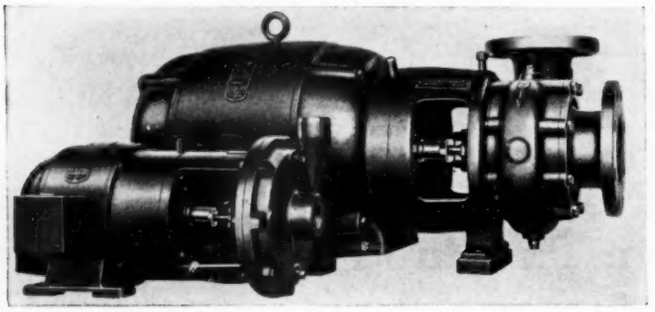
A discharge column of either the open-lineshaft type with rubber bearings for water lubrication or the enclosed-lineshaft type with metallic bearings for oil or water lubrication, may be furnished for either of the foregoing designs of turbines.

Additional Designs of Built-Together Pumps

FAIRBANKS, MORSE & CO., Chicago, has added to its line of pumps an additional design which it designates as the Built-Together type, that is, assemblies in which the motor and pump act as a single unit. These units can be furnished in capacities ranging from 10 to 900 gpm., to operate against heads of 40 to 260 ft., the discharge size ranging from 1 to 4 in.

These pumps are driven by motors varying from ¾ to 75 hp., and can be obtained to operate at speeds of 1,450, 1,750, 2,900 or 3,460 rpm.

The power unit and pump are designed to operate as an integral unit, the impeller of the pump and the rotor of the motor being carried on the same shaft. A single row of large deep-groove ball bearings are provided to withstand heavy radial and thrust loads. Sufficient grease is held in the bearing housings to serve for six months to a year of ordinary service. All parts are designed to secure rigidity. It is said that the pumps will operate in any desired vertical, horizontal or angular position, while special foundations are not required for their installation. These units are normally equipped with splash-proof motors, but explosion-proof motors can be provided if desired.



Motor and Pump Operate As an Integral Unit

A New Rigid Building Insulation

CELOTEX Vaporseal insulating sheathing is an entirely new design of rigid insulation which has been placed on the market by the Celotex Corporation. This product consists of a core of ordinary Celotex which is said to be waterproofed integrally and protected against termites and dry rot by a patented process. To give it added protection against moisture and vapor, this core is covered on both sides and all edges with a specially prepared high-melting-point asphalt which does not become sticky or tacky. In addition, one side is covered with a bright aluminum compound which affords further vapor protection. It is said that since these treatments are applied to the surface only, the insulating value of the Celotex core is not impaired.

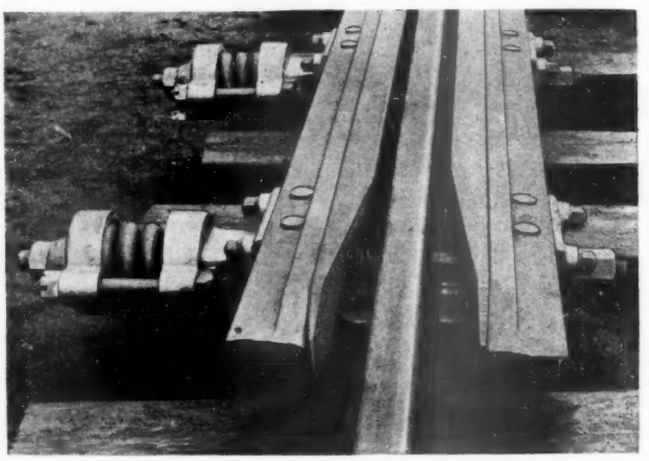
This sheathing is available in standard sizes and is 25/32 in. thick, the same as ordinary sheathing. It is claimed that this insulation does not require the use of building paper. It can be applied quickly and easily as the outside surface is marked for nailing.

Applying Celotex Vaporseal Insulation

Union Inert Car Retarder

AN inert car retarder, designed for use on tracks where there is a need for a constant amount of retardation on all cars for given weather or traffic conditions, is now available for use where required. This inert car retarder, manufactured by the Union Switch & Signal Company, Swissvale, Pa., is inexpensive and is especially adaptable for use on classification tracks of yards which handle the same type of freight, that is, either "all empty" or "all loaded" cars.

It is claimed that the use of the Union inert car retarder in classification tracks will permit the grade of such tracks to be greater than would otherwise be the case. The advantages of this increase in grade lie in the fact that it prevents hard-running cars from stalling in the upper part of the classification tracks, while it also prevents easy-running cars from reaching the lower end of the yard at too high a speed. If a change in weather or traffic conditions in the yard requires a change in the amount of retardation, this change can be made by manual adjustments. The construction of this retarder is such that locomotives with driving wheels having treads up to 6½ in. wide can pass through it at any time without damage to either the locomotive or the retarder.



Close-up View of End of Single-Rail Unit of Inert Retarder Showing Spring and Lever Arrangement

This inert retarder is of unit design and can be made up in any length required. The usual length, however, is 22 ft. 4 in. It can also be used as a single or double-rail retarder. As there is no metallic connection between the two rails, track circuits can be run through without providing special insulation.

The retardation of an inert retarder generally will be equal to that of a standard power-operated retarder of the same brake shoe length, in its lowest braking position. The inert car retarder is composed of a series of lever spring assembly units, mounted on the base of the running rail, to which a brake-beam brake-shoe assembly

is attached. The lever brake shoe and brake beam are both made from the same standard L-shaped brake-shoe section used in the Union power car retarders. The material and section of the brake shoe have been designed especially to give high retardation and long life. The brake shoe can be readily replaced when worn to the condemning limit.

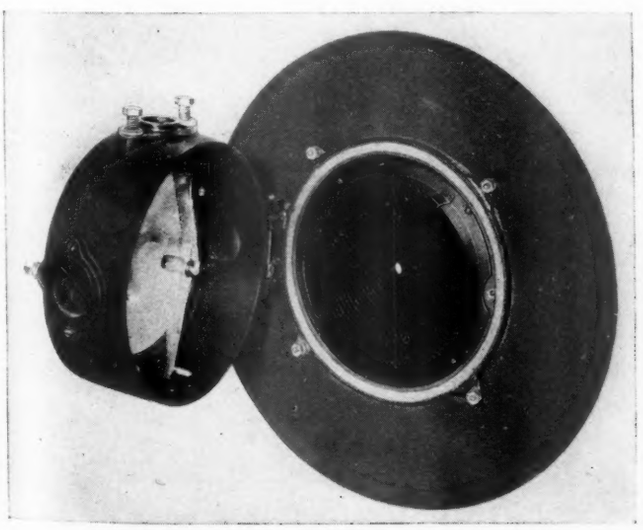
Only one retarder spring assembly is required at each lever unit to operate both inside and outside lines of the brake shoes. The brake shoes engage both sides of the car wheel in such a manner as to equalize the pressure and eliminate strain on the wheels. Very little motion of parts takes place during retardation, and this motion is a pivoting one, rather than a sliding one. All lost motion is automatically taken up by the retarder spring and the return springs. No special tie plates are required as the retarder is mounted entirely on the track rails. The only provision that is necessary to make for its installation is to drill the rail at 3-ft. 3-in. intervals to provide clearance for the lever bolt, to space certain ties, and to provide a guard rail if a single-rail retarder is used.

"Phankill" Unit for Highway Crossing Signals

WHILE the "Phankill" screen has been used in connection with color-light signals for more than 10 years, such an innovation has been considered of negligible importance in connection with flashing-light highway crossing signals until recently. With the large increase in the use of these signals, however, there have been a few cases where phantom indications, because of reflected external light, have given some trouble. To overcome this situation, the Union Switch & Signal Company, Swissvale, Pa., has designed a "Phankill" screen for use in flashing-light highway crossing signals.

The screen is made of two thin copper strips (one plain and the other corrugated), wound in a roll to conform with the shape and diameter of the cover glass. It thus presents innumerable cells, the walls of which are parallel with the axis of the lamp unit. When installed, only direct external light, which is also projected parallel with the lamp unit axis, can enter, and this is reflected to the focal point of the lamp where it is broken up by the lamp filament and socket or support.

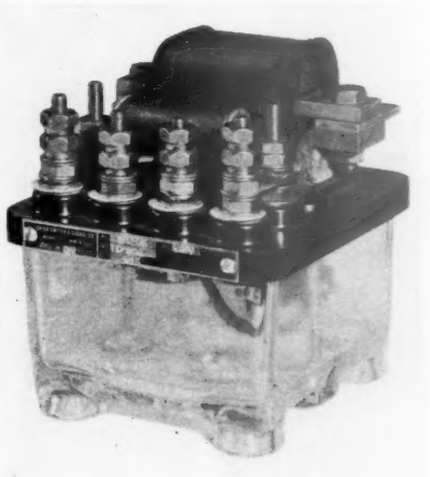
Because of the thin walls of the screen, the range of the signal indication is reduced so slightly that it is negligible. Three clips fasten the cellular screen to a mounting ring, which has four punched holes conforming with the spacing of the screws used to secure the cover glass to the door casting. The complete unit is made of copper and is oxidized to present a smooth, thin and non-corrosive finish. While the "Phankill" unit is at present designed for the Union Style HC-81 flashing-light unit and the front light of the Style HC-8 unit, to existing units of which it is applicable, it can also be furnished for application to other units.



The Special Screen for Killing Phantom Is Mounted Behind the Cover Glass

Control Relay for Battery Charging Rate

A NEW relay, DNL-46, is announced by the Union Switch & Signal Company, Swissvale, Pa., for use in connections with lead storage cells only. It is claimed that with this relay, a fully-charged battery is assured. Its "floating valve" characteristics do this without overcharging or undercharging. The relay is provided with proper temperature compensation and means for adjusting its operating voltage to suit the charge rate.



Equipment Is Mounted as One Compact Instrument

The DNL-46 relay releases each time the battery is called upon to deliver a load. The back contact of the relay shunts a resistor or reactor in series with the d-c. or a-c. supply of the rectifier, so that the charge rate may be increased up to the maximum output rating of the rectifier. This high rate is maintained until the battery reaches its fully-charged voltage value, at which time the relay picks up, opening the back contact and reducing the rate to a trickle charge value for the particular capacity of the battery used. This relay has a special temperature compensation because of the fact that the fully-charged voltage of a lead cell increases as the temperature drops, a reaction opposite that of the conventional d-c. relay, whose pick-up voltage increases directly with temperature.

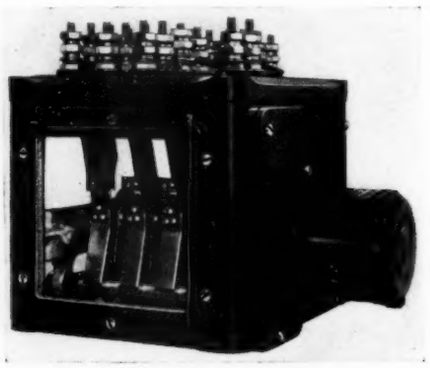
This relay will be found of value where under-voltage power-transfer relays are used, for while it is important that the batteries remain fully charged, as extra load may be applied to the batteries at certain locations on the line

when voltage drops to the release point of the power-transfer relay, it is essential that this extra load be replaced in the reserve cells as soon as possible. The DNL-46 meets these requirements.

Some of the advantages of automatic charging with a DNL-46 relay are: (1) Saving in maintainers' time checking batteries and adjusting charging rates; (2) longer life of batteries because they are not overcharged or undercharged; (3) elimination of power wastage because of overcharging; (4) water need be added less often when batteries are not overcharged; and (5) satisfaction of dependable operation.

New Code Transmitter

THE General Railway Signal Company has developed an improved design of a-c. motor-operated code transmitter for coded track circuits operated from a-c. wayside energy which is claimed to have several outstanding features. An absolute synchronous motor is used, insuring accurate operation. The motor and gear train are a self-contained unit which can be removed without disturbing the inside of the transmitter. The actuating assembly is of unit construction, and can be removed by unscrewing two cap screws. The contact assembly is also a complete unit with a bakelite top. These three unit assemblies and the case compose the device.

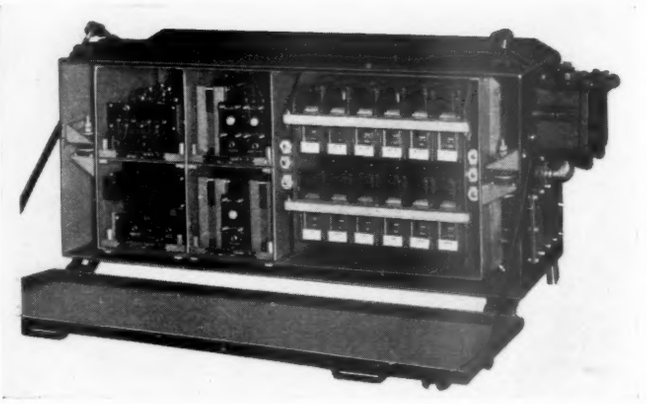


A-c. Motor Operated Code Transmitter for Coded Track Circuits

Code cams can be readily changed to provide desirable code combinations. The transmitter has a capacity of three codes for each of four independent track circuits. Provision is made for four different codes, 75, 120, 180 and 240 impulses per minute.

Improved Coded Cab Signaling

THE General Railway Signal Company has made a number of improvements in its continuous-inductive coded cab-signal equipment. The mechanism case has been reduced in weight and made more compact, thereby requiring less space on a locomotive or tender. The apparatus contained in the mechanism case consists of individual assemblies with plug-in features. This method facilitates the manufacture of 2, 3, or 4-indication systems. Furthermore, maintenance is made easier, because individual units can be removed, if that should be necessary, without disturbing other apparatus or wiring. Jacks and terminals for instruments (meters), and a power plug for a portable lamp, are now provided within the mechanism case, while the field adjustment, or replacement of individual parts of each decoder, has been made possible by the use of similar parts in all decoder assemblies.

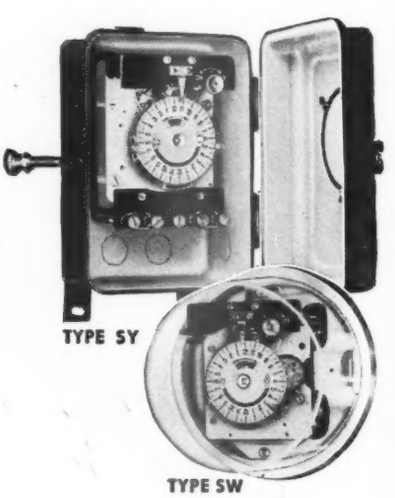


New Compact Light-Weight Locomotive Equipment for Coded Cab Signaling

New Time Switches

TWO new Sauter synchronous motor-operated time switch models, designated Type SY and Type SW, have been developed by the R. W. Cramer Company, New York City, which, like earlier models, have a number of applications on the railways, such as in controlling station platform lighting, or pumping plant equipment, where conditions call for periodic, automatic operation to insure the desired results with the greatest economy in power consumption. The new models are offered in 4- or 30-ampere capacity for 110- or 220-volt circuits, and will control almost any type of alternating current circuit on a predetermined time basis.

The motor operates a time-graduated dial of either plain or astronomic type, which, in conjunction with mechanical trips that are set at will in accordance with the operation desired, opens and closes the power line switch. Thus, as regards station platform lighting, for example, the lights can be made to light and go out automatically at night with the arrival and departure



The Two New Time Switches

of trains, or with any other arbitrary schedule set up. Another common use for the switches is in connection with off-peak power consumption in two-rate current territory. In this capacity, the switches can be set to bring about equipment operation only during the off-peak or lower rate period of the day.

In the new models, gears are accurately cut, and hardened steel pinions are used throughout. Also, the clock plates are heavy to assure substantial bearings. The Model SY switch has an all-metal housing, while the Model SW has a glass cover and is designed for mounting in a standard meter socket.

Emergency Light

THE National Carbide Corporation, New York City, has developed an emergency carbide light which is adapted especially for railway work, being light in weight, easily handled, and fool-proof in operation. The new light, which is equipped with a 13-in. chromium alloy reflector, mounted on a standpipe with a universal joint, delivers 8,000 candle power for a period of more than 3 hours, with a single 1¾-lb. charge of carbide. The reflector head and light may be ranged up or down, and laterally in any direction, and may also be folded down along the side of the hopper, giving the unit as a whole, when not in use, an overall height of 27½-in.

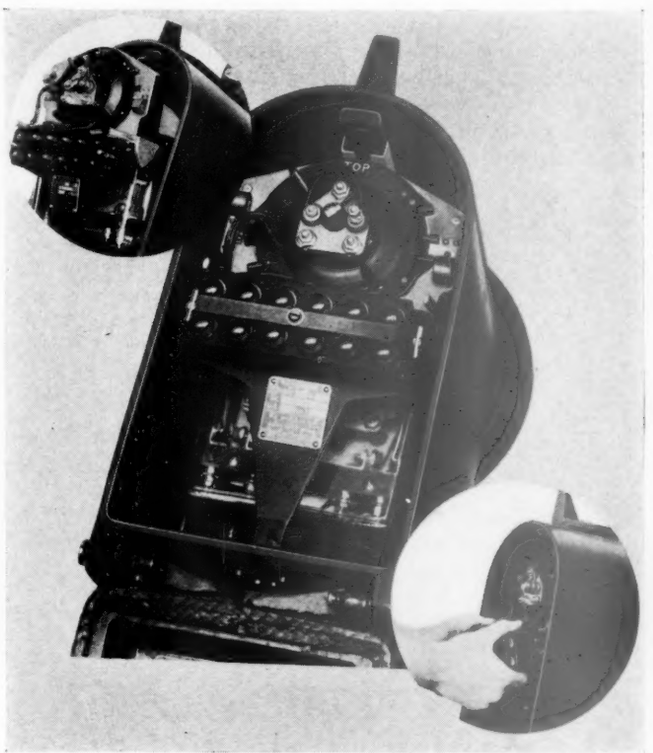
The light, which weighs 40 lb. when fully charged, and only 22 lb. when empty, can be charged and assembled, ready for immediate use, by simply releasing the carbon feed control, which forces the carbide into the water compartment. The light can be shut off at any stage of the charge and allowed to stand indefinitely without loss of carbide, and can, at will, be returned to immediate operation. Furthermore, there is no after-generation following the use of the light, so that every particle of carbide delivers its full gas content at the burner.

A feature of the light which adapts it particularly to emergency railway operations, is that it will withstand rough handling and presents no danger if turned over while lighted. Straightened up, the light will immediately continue to operate.

The New Carbide Light

Improved SA Signal

THE General Railway Signal Company has recently made improvements in the design of its Type SA signal mechanism and housing, which will greatly facilitate maintenance. The mechanism is now equipped with a terminal board having a plug coupler arrangement, so that it may be removed from service and replaced without disconnecting the field wires. Internal connections on the signal mechanism are made to the contact springs on the male half of the coupler, while field wires are connected to the corresponding posts on the female half of the coupler. After the initial field connections are made, it is only necessary to remove the female half of the coupler, with the field wires attached, in order to take the signal mechanism out of service.



A Mechanism Can Be Replaced Without Removing Wire Connections

The signal housing and mechanism case has been redesigned to simplify the removal or replacement of the inner mechanism. Slides have been added to the top and bottom of the mechanism and housing, as shown in the illustration, which guide and support the mechanism into its final locked position.

After lining up the guides on the mechanism case with those in the housing, the mechanism may be pushed home in one simple motion.

An improved type door latch on the signal housing engages a hole in an extension on the upper slide in the housing which acts as a spring latch. The door-locking screw is automatically lined up and fastened in the usual manner.

Buda Develops New Inspection Car

THE Buda Company, Harvey, Ill., has introduced a new bus-type inspection car designated as Model 719, seven cars of this model having been recently shipped to a prominent road for the use of operating and engineering officers. These cars have an all-steel body, 10 ft. 10½ in. long, outside, and 10 ft. 6½ in. inside, and provide seats for nine persons.

The power plant for these cars is a 55-hp. 6-cylinder Buda gasoline engine which is said to develop a car speed of 45 miles per hour on level track, but other engines of the same make up to 120 hp. may be specified. The transmission is provided with a reverse gear that permits operation of the car in either direction at all transmission speeds.

The bus-type seats are provided with air cushions. The right front door is equipped with a control, operated by the driver, that can be used to lock the door in either the open or closed positions. There is another door on the left side directly behind the driver and an emergency exit in the rear.

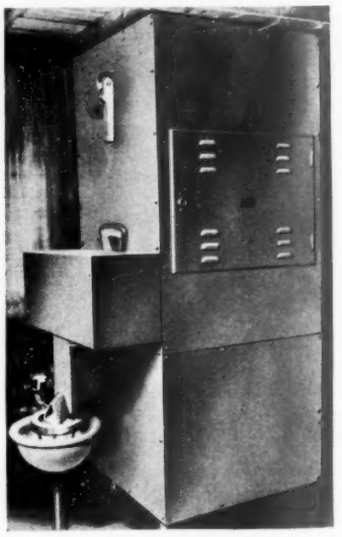
Three of the New Inspection Cars

Dry Chemical Weighing Feeder

THE Syntron Company, Pittsburgh, Pa., has developed a line of continuous, batchweighing feeder machines for dosing water with dry chemicals, which are said to operate with a high degree of accuracy. By means of these machines the desired amount of chemical is weighed in batches, which are dumped or discharged into the solution pot at regular intervals.

The essential features of these feeders consist of (1) a supply hopper equipped with a noiseless electric vibrator that prevents the arching or clogging of the chemical, (2) a vibratory feeder that conveys the chemical from the supply hopper to a weigh hopper, (3) an even balance scale carrying the weigh hopper, which is equipped with electric controls that stop the vibratory feeder when the proper amount of material has been fed into the weigh hopper, and (4) an electric clock control which dumps the contents of the weigh hopper into the solution pot at desired intervals. By means of the electric clock control, dumping rates of one, two, three or four times per minutes as desired may be obtained.

One of the machines, known as Model WMO-25, may be adjusted to deliver ⅛-ounce to 1-lb. batches per discharge. Larger models are also available. Each of the units is completely encased in a dust-tight cabinet with only the dial of the scale exposed and receives the chemical through a dust-tight chute from the floor above. All surfaces with which the chemical comes in contact are of stainless steel. Materials that the machines are said to handle successfully include activated carbon, hydrated lime, soda ash, alum, and small lump lime. These machines are said to operate with an accuracy of 0.5 per cent.



The Continuous Batchweighing Feeder

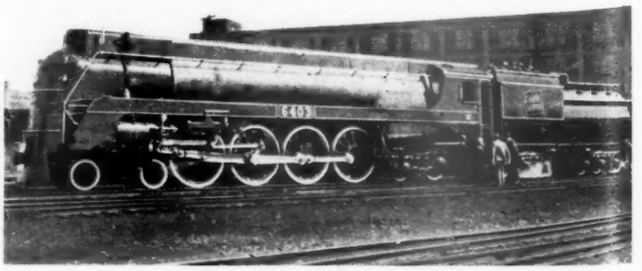
N.R.A.A. Presents Large Exhibit

(*Continued from page 512*)

membership dues and in the cost of space, as evidence of the economy with which the exhibit had been conducted. However, owing to the increased costs of materials and labor, he believed that there was little likelihood of further reduction in the cost of operating the exhibit. A preliminary report by the treasurer showed a balance of $24,943.24, or a gain of $4,759.17 during the year.

In the election of officers, Mr. Cowlin was advanced to the presidency and Mr. Rodman was elected vice-president, Mr. White was re-elected secretary and Mr. Finley was chosen treasurer; Directors elected for three years are: R. B. Fisher, Buda Company, Harvey, Ill.; and W. J. Hanna, Republic Steel Co., Chicago, and director for one year—John Hutchins, Ramapo Ajax Corp., Chicago.

* * *



One of the Canadian National's New Streamlined Steam Locomotives at Montreal

NEWS

The 1936 Reports of Canadian Roads

C. N. R. had a cash deficit of $43,303,393—C.P.R. a net of $6,029,184

The Canadian National reported for 1936 a cash deficit of $43,303,393, after provisions for taxes, rentals and interest, according to the annual report tabled in the House of Commons at Ottawa on March 15 by C. D. Howe, minister of transport. This was an improvement of $4,118,070 as compared with 1935. Meanwhile the Canadian Pacific reported a 1936 net income of $6,029,184, according to the preliminary report made public in Montreal.

Gross 1936 revenues of the C.N.R. were $186,610,489, operating expenses, $171,477,690 and net revenue $15,132,799. Taxes, rentals and other cash requirements amounted to $8,723,888 while interest on funded debt held by the public was $49,184,622. Thus the cash deficit of $43,303,393.

The report presented to the Minister by S. J. Hungerford, chairman and president, on behalf of the board of directors which took office on October 1, 1936 (replacing the trustees previously in control) points out that from the low point of $148,519,742 in 1933, revenues of the C.N.R. increased progressively up to $186,610,489 in 1936, and states that these figures "would indicate that the severity of the depression is gradually easing."

The effect of the economic disturbance on railway earnings, the report adds, may be judged from the fact that for the seven-year period 1923-1929 inclusive the gross revenues of the C.N.R. averaged $278,024,509, while for the seven-year period 1930-1936 inclusive the yearly average was $183,684,870. During 1936 all classes of revenue showed increases.

Operating expenses for the year increased by $12,551,442 or 7.9 per cent. In addition to the increased transportation expense necessitated by additional business, there were heavy expenditures necessitated by reason of ice, snow, and floods, while the policy of restriction of general maintenance of way work was relaxed to take care of expected traffic increases. Increased expenditure was also made on maintenance of rolling stock in order to bring a larger number of units to a state of efficiency on account of increased traffic and in anticipation of continued improvement.

The report shows that the Canadian National's tax bill during the year amounted to $9,743,147, of which $7,000,000 was paid in direct taxes and the remainder in sales taxes added to the cost of materials purchased. The total requirements in 1936 for interest on funded debt held by the public were $49,184,623 compared with $53,468,792 in 1935, a decrease of $4,284,169. This was brought about to a large extent by refunding operations at lower rates of interest.

The Canadian Pacific's $6,029,184 net was after deduction of provision for depreciation of ocean and coastal steamships and payment of fixed charges; it represented an improvement of $3,197,100 over 1935 when the balance amounted to $2,832,083.

The preliminary report shows an increase in gross earnings for the year of $8,883,858 to $138,562,763, an increasing in operating expenses, including taxes, of $7,970,271, and an increase in net earnings of $913,587 to $23,311,111. Other income increased $2,053,027 to $10,198,522 and fixed charges decreased $246,639.

Following are the results of operations of the company for 1936, compared with the previous year:

	1936	1935
Gross earnings	$138,562,763	$129,678,904
Working expenses*	115,251,652	107,281,380
Net earnings	23,311,111	22,397,524
Other income†	10,198,522	8,145,494
	33,509,633	30,543,018
Deprn. — Ocean and Coastal S.S.	3,567,151	3,550,997
	29,942,482	26,992,021
Fixed charges	23,913,298	24,159,938
Surplus	6,029,184	2,832,083
Pension fund	‡	‡
Net revenue	6,029,184	2,832,083
Preference dividends	¶	.....
Balance	6,029,184	2,832,083
Balance transferred to P. & L. acct.	6,029,184	2,832,083

* Including taxes.
† Net debit.
‡ Pension Fund is now non-existent. Since 1934 pension payments have been included in Working Expenses.
¶ Subsequent to the end of the year, a dividend of 1 per cent on the Preference Stock was declared from the earnings of the year 1936, payable April 1, 1937.

President Appoints Locomotive Bureau Official

President Roosevelt has appointed Allyn C. Breed assistant chief inspector of the Bureau of Locomotive Inspection of the Interstate Commerce Commission and has sent his name to the Senate for confirmation. Mr. Breed was the senior inspector in point of service in the bureau, having come with the commission on August 10, 1911. He takes the place of John A. Shirley, who was retired.

Santa Fe's Chief To Be Streamline

Plans complete for introduction of new Pullmans and other cars

Plans have been completed by the Atchison, Topeka & Santa Fe for the conversion of its Chief, operating between Chicago and Los Angeles, Calif., to a light-weight, streamline train, by the introduction of new Pullman cars, and new coaches, club cars and dining cars. Each of the six units of the ten-car train comprising the new Chief will consist of a club-baggage car, a club-lounge car and a dining car, which are now being built by the Edward G. Budd Manufacturing Company for the Santa Fe, and an observation, four-drawing room, double bedroom sleeping car; a 14-section sleeping car; an 18-roomette sleeping car; 2 two-drawing room, two-compartment, four double-bedroom sleeping cars; and 2 eight-section, two-compartment, two-double bedroom sleeping cars.

In addition, four additional dining cars and three additional sleeping cars will be included in the pool, making the total number of cars 67. The 45 sleeping cars will be constructed by the Pullman-Standard Car Manufacturing Company for the Pullman Company, while the remaining 22 cars are a portion of the 52 cars ordered by the Santa Fe from the Edward G. Budd Manufacturing Company. These 45 Pullman cars contain new features not found at present in standard sleeping cars. The drawing rooms and compartments are designed for added room and comfort, with a different layout. The roomette car is a new type, containing 18 separate, individually enclosed roomettes designed for one passenger, and containing a folding bed-type berth, washstand, toilet and wardrobe.

Thirty of the cars ordered from Budd, all coaches, will be placed in service on the Scout, the Santa Fe's all-coach tourist-sleeping car operating between Chicago and San Francisco, Calif., and Los Angeles.

I.C.C. Appoints Director of Service Bureau

The Interstate Commerce Commission has appointed Harvey Boltwood of Denver, Colo., as director of its Bureau of Service to succeed W. P. Bartel, who was recently appointed secretary of the commission. Mr. Boltwood has been employed by the commission for the past 26 years.

Canada's Transport Bill Before Senate

Early passage by that body expected now that proposal has committee O.K.

In the face of rumors that the bill of Canada's Transport Minister (Hon. C. D. Howe) for Dominion regulation of all forms of transport might be withdrawn because of increasing opposition, the measure was approved last week by the Senate Committee on Railways, Telegraphs and Harbors at Ottawa. It is expected it will be soon passed in the Senate and sent over to the House. Last minute fighting against the legislation came from the Maritime provinces where there was strenuous objection to the Minister's refusal to exempt from proposed rate regulation, vessels operating between the Maritime provinces and the head of the Great Lakes, even though Maritime inter-coastal traffic was exempted.

Strong objection was taken by the Conservative leader, Senator Arthur Meighen, to the fourth part of the bill relating to proposed federal control over interprovincial highway traffic. He thought this part should be dropped from the measure on the ground that its enactment would simply be an incitement to the provinces to engage in another constitutional encounter with the Dominion.

It was contended by Senator Meighen that, inasmuch as only little more than one per cent of highway traffic was interprovincial, it was hardly worth while for the Dominion to establish rate control over this traffic, when it might lead to difficulties with the provincial authorities. His objection was followed by a suggested amendment by G. W. Mason, K.C., appearing for the Government of Ontario and the Western Provinces, providing that none of the fourth part should become effective until proclaimed by the federal Government.

Hon. C. D. Howe, Minister of Transport, asked that this motion stand for further consideration, although he saw no reason why it should not be inserted in the bill. Later in answer to questions by Senator Haig and Senator Calder, Mr. Howe again informed the committee that that part of the bill providing for federal regulation of interprovincial and international highway traffic would not become effective until there had been agreement with the provinces affected, and that the other provision regarding federal control over intra-provincial traffic when requested by a province, would obviously not be operative unless or until there was such request and consent.

When it came to the sixth part providing for "agreed" charges (enabling the railroads to become contract carriers, as is permitted in England) and their approval by the Board of Transport before becoming effective, S. B. Brown, on behalf of the Canadian Manufacturers Association, read a short memorandum in which it was stated that this would be a "backward step and open the door to the establishment of agreements which could not help but place in the hands of large carriers and large shippers an arrangement which would tend to seriously prejudice other carriers and other shippers." He feared it would take away certain conditions of the Railway Act relating to publication of rates.

E. P. Flintoft, chief counsel of the Canadian Pacific, speaking for all the railways of Canada, pointed out that the railways should be given the same right to make agreed charges as was now accorded to such competing carriers as the vessel operators on the Great Lakes, and truck operators engaged in intra-provincial freight movements. There need be no fear, he added, that the condition of publicity would be destroyed or that a small carrier would be unduly prejudiced for, under the provisions of the bill, they were amply protected.

"God help the Government that does not see the law is administered fairly," declared Senator James Calder in the Senate Committee on Railways, Telegraphs and Harbors, which is dealing with the Transport Bill of Hon. C. D. Howe.

That the truck licensing provision was "prohibition rather than regulation," was the contention of G. W. Mason, representing the Ontario government in pointing out to the committee what he regarded as the effect of the directions to the Board of Transport in Section 29. Mr. Mason declared that a sub-section of Section 29 required that the board "shall" have in mind, "whether or not the issue of such license would tend to develop the complementary rather than the competitive functions of different forms of transport."

The real long distance truck movement today, said Mr. Mason, was between Montreal and Toronto, an area already served by the railways and the waterways. These were the "senior" transportation facilities in that area, and if the board, he argued, were told it must consider the priority of these services, then it could not do otherwise than reject applications for new truck licenses for operation in that territory.

The chairman, Senator George P. Graham, reminded Mr. Mason that a similar provision was in the Ontario law for truck regulation, that similar considerations had to be dealt with by the Ontario Railway and Municipal Board; but Mr. Mason denied the positions were identical, and asserted that the Ontario board was untrammelled in its disposition of truck license applications. He urged that the federal board be completely unfettered also and that this could be achieved only by eliminating Section 29 from the bill.

When Mr. Howe refused to delete the objectionable provision, Senator John T. Haig of Winnipeg protested that this was a direct challenge to members of the committee to vote against the whole bill.

Store Door Petition Denied

The Interstate Commerce Commission has denied the petition of the Missouri-Illinois for reconsideration and modification of the order in the eastern pick-up and delivery case so as to waive the operation of the 45 cents per 100 lb. minimum rate provision.

Plans for I. C. C.'s 50th Anniversary

Feature of April 1 celebration will be special message from the President

The Interstate Commerce Commission has announced the program for the celebration of its fiftieth anniversary, which will be held on April 1. The highlight of the celebration will be a special message from President Roosevelt, which will be read at a night meeting of prominent Interstate Commerce Commission officials and members of congress at the commission's new auditorium.

The program includes special addresses by: Senator Burton K. Wheeler, chairman of the senate interstate commerce committee; Representative Sam Rayburn, present floor leader, who for 24 years was a member and chairman of the house committee on interstate and foreign commerce; Representative Clarence Lea, present chairman of that house committee and a member for 16 years; John J. Esch, former commissioner; Patrick J. Farrell, former commissioner and now I.C.C. chief counsel; Commissioner Clyde B. Aitchison; John E. Benton, general solicitor of the National Association of Railroad and Utility Commissioners; Allan P. Matthew, president of the Association of Practitioners before the Interstate Commerce Commission; and George M. Crosland, assistant director of the I.C.C. Bureau of Traffic, and senior employe of the commission.

The practitioners association will give a dinner at the Mayflower Hotel on the night of March 31, as a part of the semi-centennial observance. A feature of the dinner will be the presentation to the commission of a bust of Thomas M. Cooley, the commission's first chairman. The George Washington Law Review is devoting its March issue entirely to the Interstate Commerce Commission.

Western Association of Railway Tax Commissioners

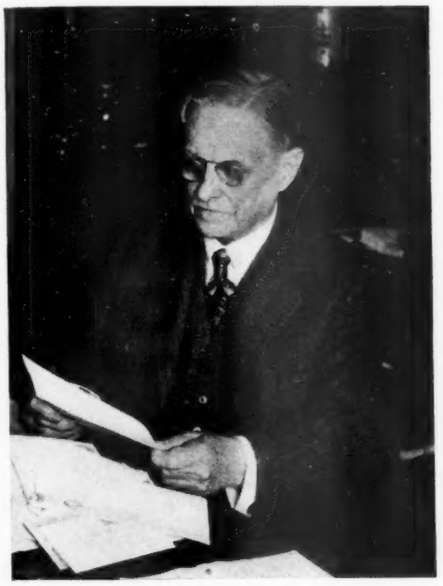
R. A. Miller, tax commissioner, Chicago & North Western, was re-elected president of the Western Association of Railway Tax Commissioners at the annual meeting held in Chicago on March 9. Other officers elected are: First vice-president, E. A. McCrary, tax commissioner, Northern Pacific; second vice-president, J. B. Angell, real estate and tax commissioner, Chicago, Rock Island & Pacific; third vice-president, F. A. Hogberg, land and tax commissioner, Illinois Central; secretary and treasurer (re-elected), K. W. Fischer, land and tax commissioner, Chicago, Burlington & Quincy.

The purpose of the association, which was formed in March, 1936, is to provide a medium for the exchange of views and to establish uniform practices in tax matters of general interest to railroad and utility companies. There now are approximately 65 members, representing 40 railroads and utility companies in the Middle West.

E. Thomson Dies; A Founder of G.E.

Dean of American Scientists had been with General Electric since 1892

Professor Elihu Thomson, dean of American scientists, and one of the founders of the General Electric Company, died at his home in Swampscott, Mass., on March 13, at the age of 83. He had been seriously ill since January. Elihu Thomson was one of America's greatest pioneers in the field of electrical science.



Elihu Thomson

His technical work was directly reflected in practical developments, as he was one of the early arc-light inventors, and experimented with the principle of alternating-current transmission far in advance of commercial demands. He held upward of 700 patents in the United States alone. He originated the resistance method of electric welding, which has been in continuous use since 1887. He developed the repulsion type of induction electric motor; invented the magnetic blow-out principle in lightning arrestors and electric switches, the oil-cooled type of transformer, the constant-current transformer, and the modern process of commercially treating fused quartz.

Professor Thomson's name was given to the Thomson-Houston Electric Company, organized in 1883, and merged in 1892 with the Edison General Electric Company to form the General Electric Company of today. He had ever since been associated with General Electric and at the time of his death was dean of that company's staff of scientists, having served for more than 15 years as director of the Thomson research laboratory, located at the River works of the company, West Lynn, Mass.

There was scarcely any aspect of electrical science in which Professor Thomson had not been active. More than 10 years before Hertz in Germany discovered the electro-magnetic waves of radio, Professor Thomson was demonstrating, in 1875 at Philadelphia, Pa., the transmission of signals without wires. He originated the three-phase electric dynamo machine in 1879 and anticipated experimentally, in the same year, the modern practice in transformer work. He invented the first practical wattmeter, thereby winning half of the grand prize at the close of the Paris electrical exposition of 1889.

Professor Thomson was the only man who ever received all three of England's highest scientific honors—the Hughes, the Lord Kelvin, and the Faraday medals. He also had the medal of the Verein Deutscher Ingenicure, outstanding German engineering award, the John Fritz medal from the four leading American engineering societies, and the medals of the Franklin Institute, the American Academy of Arts and Sciences and the American Institute of Electrical Engineers. He was president of the International Electrical Congress in 1904, and the president of the Electrochemical Congress in 1910 and 1911. At one time he was vice-president of the American Academy of Arts and Sciences and vice-president of the American Philosophical Society. He belonged to many engineering societies all over the world.

A tribute to Professor Thomson, from Gerard Swope, president, follows:

"Since the very beginning, Professor Thomson was associated with the General Electric Company, and its predecessor bearing his name, the Thomson-Houston Companies and many others throughout the world bearing his name and for the entire electrical industry were many and conspicuous.

"His interest in research, his enthusiasm for new ideas, and the advancement of young engineers continued almost to the day of his passing. His memory will long be cherished by those who knew him, and he leaves a fine tradition and inspiration for those who follow him."

Owen D. Young, chairman of the board of the General Electric Company paid him this tribute: "Mr. Thomson was one of the few great pioneers in the electrical field who had the rare good fortune to see his vision become a reality and to receive the appreciation of a justly grateful world for his contribution to the health and happiness of people everywhere. The General Electric Company was always proud of his intimate association with it."

Pettengill Bill Reports

Representative Pettengill, a member of the House committee on interstate and foreign commerce, has submitted the majority report on his long-and-short-haul clause bill which has been favorably reported by the house committee. The report summarizes the evidence which was submitted to the committee in favor of enactment of the bill. A minority report was signed by Representatives A. L. Bulwinkle, Virgil Chapman, William P. Cole, Jr., George G. Sadowski, Jerry J. O'Connell, Lyle H. Boren, and Pehr G. Holmes. No date has been set for a vote on the bill in the House.

I. C. C. Secretary Long in Service

W. P. Bartel first joined staff of regulatory body in 1906

William P. Bartel, whose appointment as secretary of the Interstate Commerce Commission was announced in the *Railway Age* of March 13, was born at La Crosse, Wis., January 25, 1886. He attended La Crosse schools and in 1902 came to Washington to accept a clerical position in the National Museum. He entered the service

(c) Harris & Ewing

William P. Bartel

of the commission May 2, 1906, as a clerk in what is now the Bureau of Informal Cases.

Mr. Bartel has had a wide range of experience with the commission in the Bureau of Informal Cases; as assistant chief examiner and as secretary and examiner in the offices of Commissioners Clark, Anderson and Aitchison. He was assistant director of the Bureau of Service from October, 1920, except for a short interval, until April, 1923, when he became director of that Bureau, the position which he held until his appointment as secretary to succeed the late George B. McGinty.

He is a graduate of the Georgetown Law School; is a member of the District Bar, and has been admitted to practice before the Supreme Court of the United States.

Dr. Alfred D. Flinn Dies; Was Engineering Leader

Dr. Alfred Douglas Flinn, director of the Engineering Foundation and a leader in organized engineering, died of a heart ailment on March 14 at Scarsdale, N. Y., after a prolonged illness. Dr. Flinn, who was 67 years old, was born at New Berlin, Pa.

Ticket Case Won After Long Fight

Two-year litigation results in Illinois Court upholding scalper's conviction

For the first time on record a railroad ticket scalping case has been carried to the Illinois Supreme Court on a question of law in which the information was attacked and the case therefore tried on its own merits, with the result that the defendant was convicted after two years of litigation. In this case, Jim Lewis, a bus agent at Chicago, was arrested five times for unlawfully selling return portions of railroad tickets. In the first instance he was found guilty and placed on probation. In the second a mistrial was declared, and in the third, after two jury trials, it was ruled that the defendant had been placed in jeopardy. The fourth never came to trial, while in the fifth, upon which this decision was based, the defendant was found guilty before a jury and sentenced to 60 days in the house of correction.

This case was appealed to the First District Appellate Court of the State of Illinois, which rendered a decision affirming the decision of the trial court on April 22, 1936. The defendant appealed the decision of the Appellate Court to the Supreme Court, and finally a decision was rendered on February 4, 1937, causing the incarceration of the defendant.

This is the first case of which the Railway Ticket Protective Bureau has any record that has gone up to a Supreme Court on a question of law in which the information was attacked and the case tried on its merits. There has been only one previous case in Illinois in which the ticket scalping statute has been tested, namely, that of People vs. Burdick, decided in 1894. This case involved an injunction proceeding on the equity side of the court and, therefore, was not of much value when cited in the city municipal courts as authority for an arrest under the state scalping law, based upon tickets sold by scalpers.

The Lewis case was appealed primarily on two grounds: First, that the complaint as alleged in the information was incomplete under the Illinois statutes; and secondly, that the defendant had been entrapped. The defense contended that the allegations in the complaint did not state a cause of action, and because all six sections of the act were alleged as having been violated, and because the exceptions contained in these sections were not specifically negative in the information, the defendant did not know the crime for which he was charged.

The defense in this case alleged that the investigator, being an employee of the Railway Ticket Protective Bureau, which was in turn the agent for the railroad whose ticket was purchased, had by this employment consented to the purchase, thus entrapping the defendant into making the sale. The court, however, contended that it is not an instigation or solicitation to crime for an individual or officer to furnish an opportunity for the commission of a criminal offense, if the purpose is in good faith to secure evidence against the person guilty of crime, and not to induce an innocent person to commit a crime.

New York Railroad Club

The New York Railroad Club's April 16 meeting, to be held in the auditorium of the Engineering Societies building, 29 West 39th Street, New York, will be "Purchases and Stores Night." Among the speakers will be C. D. Young, vice-president of the Pennsylvania; R. C. Harris, general storekeeper, Pennsylvania; F. S. Austin, assistant purchasing agent, New York Central; G. O. Beale, chief purchases and stores officer, Chesapeake & Ohio, and C. E. Smith, vice-president of the New York, New Haven & Hartford. Entertainment will be provided by the Railway Express Glee Club.

Failure of Proof of Cause of Accident to Passenger

The Georgia statute, Code 94-1108, provides that in actions against railroad companies for damages proof of injury inflicted by the running of locomotives or cars shall be prima facie evidence of want of reasonable care and skill. But when the presumption is rebutted by evidence it disappears from the case and the burden is on plaintiff to prove negligence as alleged by a clear preponderance of the evidence. In an action against the Southern railway by a passenger who had his leg run over by the train from which he had alighted, the Fifth Circuit Court of Appeals, Brooks v. Southern, 86 F. (2d.) 920, affirming judgment for defendant in the Federal District Court for northern Georgia, found plaintiff's testimony as to the cause of the accident vague, indefinite and inconclusive, and overcome by the evidence of the train crew, leaving the cause of the accident to speculation and conjecture, authorizing a directed verdict for the railroad company.

Preliminary Reports Show Rise in February Revenues

Preliminary reports from 91 Class I railroads, representing 81.4 per cent of total operating revenues, made public by the Association of American Railroads, show that those railroads, in February, had estimated operating revenues of $259,228,638 compared with $244,509,004 in the same month of 1936 and $341,232,821 in the same month in 1930. The February revenues were six per cent above those for February, 1936, but 24 per cent below February, 1930.

Freight revenues of the 91 Class I railroads amounted to $212,834,839 in February, compared with $199,663,891 in February, 1936, and $263,602,980 in February, 1930, being 6.6 per cent above the same month of 1936, but 19.3 per cent below the same month in 1930. Passenger revenues totaled $26,252,397 in February, compared with $25,776,813 in February, 1936, and $49,138,736 in February, 1930—1.8 per cent above the same month of 1936, but 46.6 per cent below the same month in 1930.

Holding Company Rapped in Report

Preliminary findings of the Wheeler probe suggest new controls

Holding that Congress should revise section 5 of the Interstate Commerce Act, in order to make unnecessary "fine-spun argument" concerning its meaning and should state a clearly defined policy with respect to the activities of super holding companies such as Midamerica Corporation, but that such revision should await more careful study of the holding company problem, Senator Wheeler's subcommittee investigating railroad financing has submitted a preliminary report of its activities and findings to the senate. The report was drawn up in the hope that it might influence the senate in voting the committee an additional $150,000 to continue the investigation during the present year. Evidently, the report has had its desired effect as the senate on March 15 approved a resolution introduced by Senator Wheeler which would allow the committee to use up to $150,000 from the contingent fund of the senate.

The preliminary report summarizes the evidence brought out before the subcommittee at its public hearings during the past few months, and points out that the Midamerica Corporation, which is controlled by George A. Ball, Muncie, Ind., glass manufacturer, purchased the securities of the Alleghany Corporation at a price which was less than 10 per cent of their market value. The report states that the "empire" which Mr. Ball purchased had a market value of approximately $3,000,000,000.

The report goes on to point out that "The record brings out in sharp relief two salient general propositions: One, that irresponsible persons can acquire control of a railroad system as large as this if the system is organized in a holding company pyramid; the other, a corollary, that the interests not only of investors in such enterprises but those of employees, of shippers, of the traveling public, and of the innumerable other persons affected by the management and financing of the country's railroads are subject to the danger that, by the device of holding company pyramids, such control once acquired may be maladministered without restraint except the self-restraint of a person who happens to have had some thousands of dollars and a certain amount of luck and ingenuity.

"This freedom from effective regulation is strikingly illustrated by the fact that this transaction, whereby control of the Alleghany railroad empire was handed back to Messrs. Van Sweringen and later transferred to Mr. Ball, has never been subjected to the scrutiny of any governmental agency, State or Federal, other than this sub-committee.

"The Midamerica transaction squarely raises these questions: (1) Under existing legislation does the Interstate Commerce Commission have power either to pass upon an acquisition of this nature or to

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exercise effective supervision of the use of the control so acquired to the extent necessary to protect the public interest; (2) is it necessary or desirable for the Commission to have such power; and (3) if necessary or desirable, what form should such power take, what should its scope be, and how should it be administered.

The committee concludes by saying that "Congress should revise section 5 of the Interstate Commerce Act, in order to make unnecessary fine-spun argument concerning its meaning and should state a clearly defined policy with respect to the activities of super holding companies such as Midamerica Corporation.

"The committee believes, however, that such revision should await more careful study of the holding-company problem; whether as the President recommended in 1933, it is worth trying to control this type of organization, as the carriers themselves are controlled, or whether it would be wiser to forbid them altogether, and have the railroads owned, operated, and managed under a simple and visible corporate structure.

"In any event, the committee believes the present record demonstrates that amendment is desirable so as to make it unequivocally clear that the Commission has authority to supervise the accounts and and security transactions of holding companies which control railroads indirectly as well as those which control railroads through direct stock ownership irrespective of whether such control existed prior to or was established after the 1933 amendments to section 5 of the Interstate Commerce Act.

"The committee is convinced that further study of the operation of holding companies in the railroad field is necessary to the formulation of adequate legislative recommendations.

"There is evidence, also, of a disposition on the part of those who control vast holding companies (such as the Midamerica controlled Alleghany Corporation) to transfer properties from one company to another within the system with disregard for the interests of one of the companies, and of the investors in it who happen not to be investors in the other. The extent of these practices, their variations, and the extent to which they may be further facilitated as a result of control of the system by unsupervised holding companies requires careful study. They are to some extent touched upon in another report of this committee now in preparation.

"The committee believes that extensive study is desirable also to reach a firm basis for determining whether such remedy as is necessary should take the form of supervision and regulation or whether the privilege of utilizing holding-company pyramids should be limited or prohibited. The complexities of organization and the confusion of interests and activities which the holding company invites suggest the possibility that the difficulty of Government supervision may be so great as to justify prohibition of holding companies. There may be a point beyond which supervision cannot be effective without inordinate cost, or, perhaps, cannot be effective at any cost.

"These and other circumstances bearing upon the nature of appropriate regulation of super-holding companies such as Midamerica require further careful detailed analysis of these complicated corporate structures and considered appraisal of their effect upon the national transportation system."

Chicago Traffic Club Elects Officers

Officers elected for the Traffic Club of Chicago for the ensuing year, at a meeting on March 16, are as follows: President, J. E. Weller, traffic manager of the Pennsylvania; first vice-president, R. W. Campbell, manager, traffic department of the Butler Paper Corporation; second vice-president, W. C. Douglas, assistant general freight traffic manager of the New York Central; third vice-president, E. R. Gustafson, assistant traffic manager of the Universal Atlas Cement Company; secretary, D. W. C. Becker, director, traffic management department of LaSalle Extension University; and treasurer, R. J. Wallace, traffic manager of the Jaques Manufacturing Company.

Heads New York Bureau of Indian Railways

The India Railways Bureau has announced the appointment of Vincent L. Dean as resident manager of the bureau, with headquarters in New York. Mr. Dean received his early training on the former London & North Western. In 1914 he was appointed assistant traffic superintendent of the Indian State Railways by the Secretary of State for India. He subsequently served as district traffic superintendent. During the past three years Mr. Dean has been principal of the Walton Training School of the North Western Railway of India, which post he resigned to take over his new duties as resident manager of the India Railways Bureau.

Bills Introduced in Congress

Senator Truman of Missouri has introduced a bill which states that nothing in the Motor Carrier Act of 1935 shall apply to or be construed to affect trolley busses or motor busses operated as a part of a street railway system primarily engaged in serving a municipality or contiguous municipalities.

Representative Buck of California has introduced a bill which would amend section 3 of the Interstate Commerce Act, by adding the following sentence: "If a shipper or consignor causes notice to be given the delivering carrier to deliver freight transported by it only upon payment of all tariff rates and charges thereon and delivery is made without such payment, the shipper or consignor (irrespective of whether the shipper or consignor is also consignee) shall not be liable (as consignor or consignee, or otherwise liable) to the carrier for such tariff rates and charges."

Pacific Railway Club Elects Officers

At its twentieth anniversary banquet in Palace Hotel, San Francisco, March 11, the Pacific Railway Club elected and installed the following officers to serve during the coming year: President, Homer Bryan, locomotive engineer, Western Pacific; first vice-president, Stuart Daggett, professor of transportation, University of California; second vice-president, William P. St. Sure, vice-president Key System, Ltd., and East Bay Transit Company; treasurer, Clinton A. Veale, assistant superintendent, Southern Pacific. William S. Wollner, who has been the club's executive secretary since its organization in 1917, will continue in that office. The guest of honor and principal speaker at the banquet was Dr. C. S. Duncan, of Washington, D. C., economist of the Association of American Railroads, whose topic was "Two Decades of Transportation." Roy W. Hunt, fuel supervisor of the Santa Fe, presided as retiring president and installing officer.

The James F. Lincoln Arc-Welding Foundation

To stimulate intensive study of arc welding $200,000 will be distributed by the James F. Lincoln Arc Welding Foundation among winners of 446 separate prizes for papers dealing with arc welding as a primary process of manufacture, fabrication or construction in eleven major divisions of industry. The principal prize winner will receive not less than $13,700. Other prizes will range from $7,500 to $100, the latter sum to be awarded to each of 178 contestants who receive no other prize, but whose papers are adjudged worthy of honorable mention.

Among the eleven major divisions of industry eligible in this contest are the railroad field, the automotive field, the structural field and functional machinery. In the railroad field twenty-four prizes, with a total value of $14,200, will be awarded for the best papers on locomotives, freight cars, passenger cars, or locomotive and car parts. In the structural field there are twenty-four prizes, with a total value of $14,200, for the best papers on buildings, bridges, houses and miscellaneous.

The contest will close June 1, 1938. For complete details of the rules and conditions covering awards address the "Secretary, The James F. Lincoln Arc Welding Foundation, P. O. Box 5728, Cleveland, Ohio."

I.C.C. Approves Keeshin Acquisition

The Interstate Commerce Commission, Division 5, has authorized the Keeshin Transcontinental Freight Lines, Inc., to acquire control of the Seaboard Freight Lines, Inc. (Connecticut); S.F.L., Inc. (New York), Seaboard Freight Lines, Inc. (Massachusetts); and the United Motor Lines, Inc. (Connecticut), by purchase of the capital stock. The commission has authorized the transaction subject to the following conditions: (a) That the price to be paid for the capital stock shall not exceed $200,000; (b) that Keeshin shall be under no obligation to enter into employment contracts with vendors; (c) that Keeshin shall not enter into a contract with any one of the vendors covering a period of more than one year from the consummation date of the purchase; and (d) that Keeshin shall not pay compensa-

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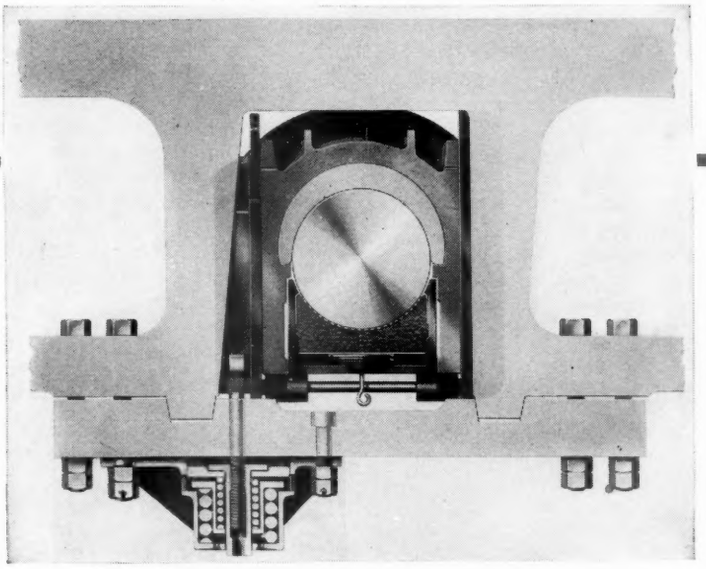
A *Perfect* FIT

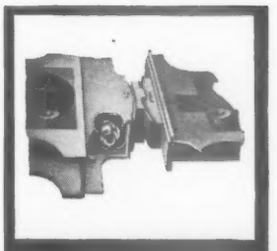


Even with accurate driving box adjustment in the roundhouse the ordinary driving box wedge cannot compensate for temperature changes that cause tight fits and excessive wear. It cannot yield to unusual shocks that excessively strain motion work and pound bearings out of round.

Franklin Automatic Compensator and Snubber provides accurate driving box fit, compensates for temperature change and maintains this accuracy at all times. In event of excessive shocks it provides a yielding resistance that cushions the blow and avoids overstressed parts.

Its automatic action maintains accuracy of adjustment, keeps parts in alignment, thus reducing wear and maintenance.

Together with its twin, the Type E-2 Radial Buffer, to maintain correct relationship between engine and tender, they greatly reduce maintenance costs and make an easier riding locomotive.



Franklin Type E-2 Radial Buffer dampens oscillation between engine and tender and makes for easier riding.

Booster Repair Parts made by the jigs and fixtures that produced the original are your best guarantee of satisfactory performance.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

tion under any employment contract with a vendor at an annual rate in excess of $10,000.

Absorbing Cost of Compressing Cotton

The Louisville & Nashville sued a shipper for $476 as undercharge for transporting 500 bales of cotton linters from Decatur, Ala., to Savannah, Ga. The railroad had agreed before shipment to absorb the cost of ordinary compression if the cotton were compressed at high density at Decatur. The shipper paid the freight, $984, and the railroad paid the compress company $476, the cost of ordinary compression. By the export bill of lading the railroad had the privilege of compressing the linters at its own cost and risk for greater convenience in handling or forwarding. The Fifth Circuit Court of Appeals, L.&N. v. Williamson, 87 Fed (2d.) 34, held that the question whether the compression of the cotton was for the benefit of the railroad and not a disguised rebate entitling the railroad to recover the amount paid by it for the compression was for the jury, the contract benefiting both parties. Judgment on verdict for defendant in the Federal District Court for northern Georgia was affirmed.

A.S.M.E. Semi-Annual Meeting

Plans for the 1937 semi-annual meeting of the American Society of Mechanical Engineers, to be held at the Hotel Statler, Detroit, Mich., May 17 to 21, inclusive, include a series of six general sessions, mornings and evenings, with plant visits and simultaneous sessions of the various professional divisions on the afternoons of the same days. The general sessions will conclude with a dinner on Thursday evening, May 21, during which honorary membership will be bestowed upon Alex Dow, a past president of the society.

Among the papers of particular interest to be presented at the spring meeting are:

Tuesday morning, May 18

Modern Locomotive and Axle Testing Equipment, by T. V. Buckwalter, vice-president, Timken Roller Bearing Co., and O. J. Horger, research engineer, Timken Roller Bearing Co., Canton, Ohio.

Wednesday morning, May 19

The Aspects of Automotive Engineering which Have Been Applicable to Railroading, by Edward G. Budd, president, Edward G. Budd Mfg. Co., Philadelphia, Pa.

The Economics of Power for Light-Weight Trains, by Dr. Rupen Eksergian, Edward G. Budd Mfg. Co., Philadelphia, Pa.

Friday morning, May 21

Notes on High-Speed-Diesel-Engine Maintenance Related to Railway Service, by I. I. Sylvester, special engineer, Canadian National Railways, Montreal.

Income Bonds Defended at C. & E. I. Hearing

Representatives of banking, investment and insurance interests, led by Kenneth D. Steere, chairman of the Chicago & Eastern Illinois board of directors, told the Interstate Commerce Commission at its hearing on the reorganization of that road on March 15 that the unnecessary destruction of a mortgage lien position by the substitution of preferred stock for income bonds in new capital structures not only will seriously impair railroad credit, particularly among institutional investors, but will cause years of expensive litigation. The hearing was held for the purpose of presenting evidence in support of the income bonds which were proposed by the revised plan or reorganization. Mr. Steere said that "it is vitally important to the railroad world that without the gravest kind of reasons you do not adopt a policy which closes the doors of these great financial institutions as a source of future financing. If you drive us out of this investment market then our only source of financing will be in the speculative market."

I.C.C. Postpones New York Warehousing Case Order

Granting a request of Judge Murray Hulbert of the U. S. District Court, southern district of New York, the Interstate Commerce Commission has postponed from April 15 to June 15 the effective date of its order in the New York Warehousing case. The last order of the commission, affirmed on February 2, directed the railroads serving New York harbor by April 15 to cease and desist from leasing space and performing storage and handling service on railroad properties for shippers at rents and charges less than the actual cost to the railroads, including full depreciation and return on investments. The railroads then filed in the New York court an injunction to restrain the commission's order.

The commission said that the postponement was granted in view of Judge Hulbert's request and in order to convenience the court. The petition of the railroads states that the current warehousing charges are the rates now charged by private warehouses for similar space and services.

Port of New York Authority Annual Report

The Port of New York Authority reported for the year ended December 31, 1936, a combined net income of $4,428,574 as compared with a 1935 net of $3,346,143. The Holland tunnel and the George Washington bridge are the Port Authority's profitable enterprises since deficits were reported by the Arthur Kill bridges, the Bayonne bridge and the Port Authority Commerce building, which houses New York's Union Inland Freight Terminal.

The Commerce building lost $39,653 in 1936 as compared with a 1935 deficit of $336,362. The report reveals that the building is now 100 per cent rented. Mention is also made of the Port Authority's part in last year's hearings on the eastern storedoor delivery tariffs, which resulted in the naming of the Union Inland Freight Terminal as one of the points at which shippers might receive the 5 cents per 100 lb. allowance for handling their own freight. This station was not listed until the Port Authority's protest. The report goes on to restate the Authority's position in that case to the effect that the trucking services in connection with New York storedoor service should be jointly operated "in the interest of reducing costs, eliminating street congestion and minimizing interference with shippers' platform operations." Noting that the Interstate Commerce Commission did not attach to its approval of the tariff a condition requiring such co-ordinated operations, the report says that "for the present it appears that complete co-ordination of Union Inland Terminal operation with storedoor delivery service of carriers will depend upon voluntary action on their part to apply to freight handling the efficient principles which they already have adopted in operation of the Railway Express Agency."

Club Meetings

J. C. Irwin, valuation engineer of the Boston & Albany, was elected president of the New England Railroad Club for the 1937-38 term at the annual election on March 9. Other officers elected are: Vice-president, William F. Cummings, assistant chief engineer, Boston & Maine; treasurer, C. H. Sherburne; secretary, William E. Cade, Jr. The next meeting of this club will be held on April 13 at the Hotel Touraine, Boston, Mass. C. C. Bailey, of the Transportation department of the General Electric Company, will speak on "Cutting Costs Electrically for a Better Operating Ratio."

The Canadian Railway Club will hold its next meeting on April 12 at the Windsor Hotel, Montreal. Dr. Charles Camsell, Canadian deputy minister of mines and resources, will be the speaker. Dr. Camsell's talk, originally scheduled for February, was postponed until this April meeting.

The Car Foremen's Association of Chicago will hold its next meeting on April 12 at the La Salle Hotel, Chicago. K. F. Nystrom, superintendent car department, Chicago, Milwaukee, St. Paul & Pacific, will speak on freight car maintenance.

The Eastern Association of Car Service Officers will hold its regular spring meeting on March 25 at the Hotel Hamilton, Washington, D. C.

Strike Threat in Canada

Further efforts made by the Dominion Minister of Labor, Hon. Norman Rogers, to re-open negotiations between employers and employees to avert the railway strike, threatened because arbitrators refused to restore peak wage rates, have so far proved fruitless. Last week at Ottawa the Minister was successively in conference with the heads of the two roads, Sir Edward Beatty of the Canadian Pacific and S. J. Hungerford of the Canadian National, and the representatives of the employees but nothing came of it. Union officers insist there will be a strike, while the view held in employers' circles is that there will not be any such disturbance of this public service.

The various employees' organizations have continued to demand restoration of the basic wage. Resolutions have been passed at their various meetings, their spokesmen citing the wage restorations on United States lines operating in Canada and protesting against "discrimination" against employees of Canadian railroads. At present, it is asserted, American wage rates are about 17½ per cent higher on the average than the Canadian.

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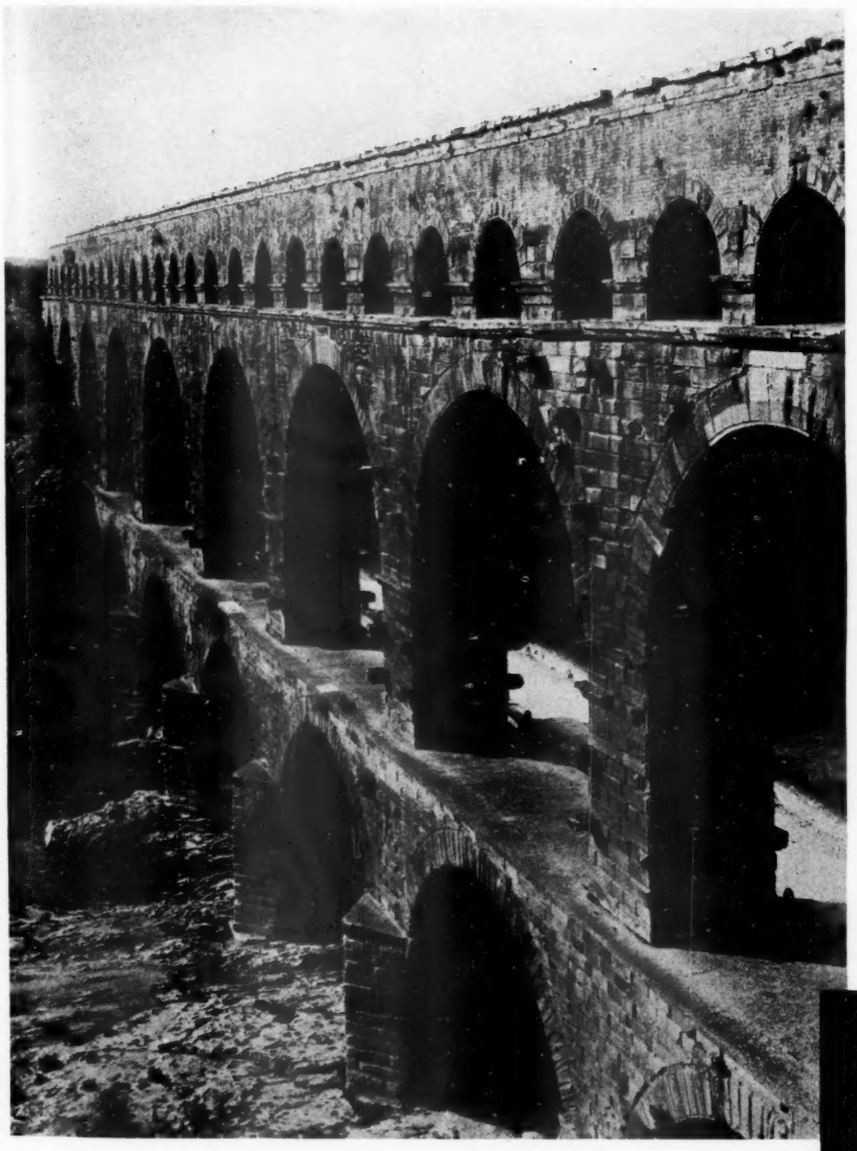
NO. 7 OF A SERIES OF FAMOUS ARCHES OF THE WORLD



PONT DU GARD
NÎMES

Among the most noteworthy architectural and engineering memorials of Roman genius are the Roman aqueducts. The Pont du Gard, near Nîmes in Southern France, is perhaps the best preserved of these aqueducts. It was built about 18 B.C. It is ten feet wide at the top, 880 feet long, and, at the highest point, is 160 feet high. It consists of three massive tiers of arches, one above the other, and was used to carry the water of the Eure and Airon across the Gard River.

Supply Trade

Westinghouse Electric & Manufacturing Company

The Westinghouse Electric & Manufacturing Company reported for the year ended December 31, 1936, a net income of $15,099,291 as compared with a 1935 net of $11,983,381.

Orders received during last year totaled $182,521,304, an increase of 48 per cent over 1935. Sales billed totaled $154,469,031, an increase of 26 per cent over the previous year. The balance sheet as of December 31 shows total current assets of $111,933,138, as compared with total current liabilities of $15,268,600—a net working capital of $96,664,538.

The consolidated income and surplus accounts for the years 1935 and 1936 follow:

Consolidated Income and Surplus

YEARS ENDED DECEMBER 31, 1936 AND 1935

	Year Ended December 31, 1936	Year Ended December 31, 1935
NET SALES	$154,469,031	$122,588,556
COST OF SALES: Manufacturing cost and distribution, administration and general expenses — including taxes (except federal income normal tax and surtax on undistributed profits), service annuities, operating reserves and depreciation of buildings and equipment	135,335,814	111,714,041
PROFIT FROM SALES	$19,133,217	$10,874,515
OTHER OPERATING PROFIT: Current operating results of subsidiary companies not consolidated in detail	1,129,048	413,353
PROFIT FROM OPERATIONS	$20,262,265	$11,287,868
INCOME CHARGES: Dividends and interest on investments (credit)	$921,215	$1,577,326
Flood rehabilitation expense	1,875,960	.....
Excess and idle facilities expense	817,412	813,265
Interest, discount and miscellaneous income, net (credit)	197,084	1,929,011
TOTAL (1935, credit)	$1,575,073	†$2,693,072
NET PROFIT before provision for following federal taxes	$18,687,192	$13,980,940
Income normal tax	$3,180,430	$1,997,559
Surtax on undistributed profits	407,471	.....
TOTAL	$3,587,901	$1,997,559
NET INCOME for the year	$15,099,291	$11,983,381
SURPLUS at beginning of year	45,205,865	40,620,427
SURPLUS before adjustments and dividends	$60,305,156	$52,603,808
ADJUSTMENT CHARGES: Adjustment in value of investments (1935, credit)	$106,706	$598,953
Adjustment on Radio Corporation of America stock distributed as a dividend	.....	‡2,230,552
Miscellaneous, net (1935, credit)	15,045	450,475
TOTAL	$121,751	$1,181,124
SURPLUS before dividends	$60,183,405	$51,422,684
DIVIDENDS: On preferred capital stock	$439,867	$247,740
On common capital stock	14,196,759	5,969,080
TOTAL	$14,636,626	§$6,216,820
SURPLUS at end of year, including $16,293,860.00 paid-in surplus representing premium on sale of additional common capital stock in 1929	$45,546,779	$45,205,864

Provision for plant and equipment depreciation for all companies for 1936 amounted to $4,592,283.25, compared with $4,946,251.04 for 1935.

† Includes profit of $1,606,625.87 representing dividends received and profits realized from securities of Radio Corporation of America sold during the year.

‡ Difference between value, as carried on books of this Company, of Radio Corporation of America stock distributed as a dividend and market value at date of declaration of such dividend or $3.50 optional cash dividend per share on preferred stock.

§ In addition to the cash dividend aggregating $1.00 per share paid on common stock, the dividend represents market value at date of declaration of Radio Corporation of America common stock distributed as a dividend or $3.50 optional cash dividend per share on preferred stock.

John Graham Morrissey has been appointed sales manager, eastern district, of the **Pressed Steel Car Company, Inc.,** with headquarters at New York. Mr. Morrissey was born at St. Paul, Minn., and attended the University of Minnesota, leaving there to serve in the United States Army during the World War. On his discharge, in 1920, he was employed in the operating department of the Pressed Steel Car Company, at McKees Rocks, Pa. A year later he was transferred to the sales department at New York, where he has been up to the present time.

Charles S. Payson, of New York, has been elected a director of **The American Rolling Mill Company,** Middletown, Ohio. Mr. Payson is also a director of the Rustless Iron Corporation, Baltimore, Md.

Fairbanks, Morse & Company, Chicago, have adopted a profit-sharing plan for employees, effective January 1, 1937, whereby employees who, on April 1, 1938, have been with the company since January 1, 1937, will share in annual net profits, after provision is made for a seven per cent return on invested capital. The employees' share in such remaining net profits will amount to 15 per cent of the first $500,000, 20 per cent of the next $500,000 and 25 per cent of any additional profits.

Equipment and Supplies

LOCOMOTIVES

THE ATLANTIC COAST LINE has under consideration the question of buying a number of new locomotives.

THE LEHIGH VALLEY has ordered 10 locomotive tenders from the American Locomotive Company. The tenders will have a capacity of 30 tons of coal, and 20,000 gal. of water.

FREIGHT CARS

THE PENNSYLVANIA is inquiring for 1,000 box cars, 1,500 gondola cars, and 300 covered hopper cement cars.

THE CENTRAL OF GEORGIA is inquiring for 500 box cars of 50 tons' capacity, and 100 box cars of 40 tons' capacity.

THE GRAND TRUNK WESTERN has ordered 100 refrigerator cars and 200 automobile cars from the Pullman-Standard Car Manufacturing Company. Inquiry for this equipment was reported in the *Railway Age* of February 13.

THE MINNEAPOLIS, ST. PAUL & SAULT STE MARIE is inquiring for 250 to 350 box cars 50 ft. long; 100 box cars 40 ft. long; 100 hopper cars; 100 general service cars and 100 ballast cars, all of 50 tons capacity.

THE ATLANTIC COAST LINE is inquiring for 100 to 400 box cars of 50 tons' capacity; 100 automobile cars, 40 ft. 6 in. long, to be equipped with loaders and to have a capacity of 50 tons; 100 automobile cars, 50 ft. 6 in. long, of 50 tons' capacity and 100 phosphate cars of 70 tons' capacity.

PASSENGER CARS

THE ATLANTIC COAST LINE is inquiring for 15 all steel coaches, and 15 express cars, 70 ft. long.

IRON AND STEEL

THE CAMBRIA & INDIANA has ordered 350 tons of rail for early delivery.

NEW YORK CENTRAL.—Bids will be received on March 23 for 500 tons of steel for grade crossing elimination work at Schenectady, N. Y.

SIGNALING

CHICAGO, ROCK ISLAND & PACIFIC.—The trustees have applied to the Interstate Commerce Commission for permission to be relieved of further maintenance and operation of certain automatic train control devices on the Chicago and Rock Island divisions between Blue Island, Ill., and Rock Island.

MOTOR VEHICLES

THE CONNECTICUT COMPANY, an affiliate of the New York, New Haven & Hartford, has ordered from the American Car & Foundry Motors Company 18 buses powered with Hall-Scott engines.

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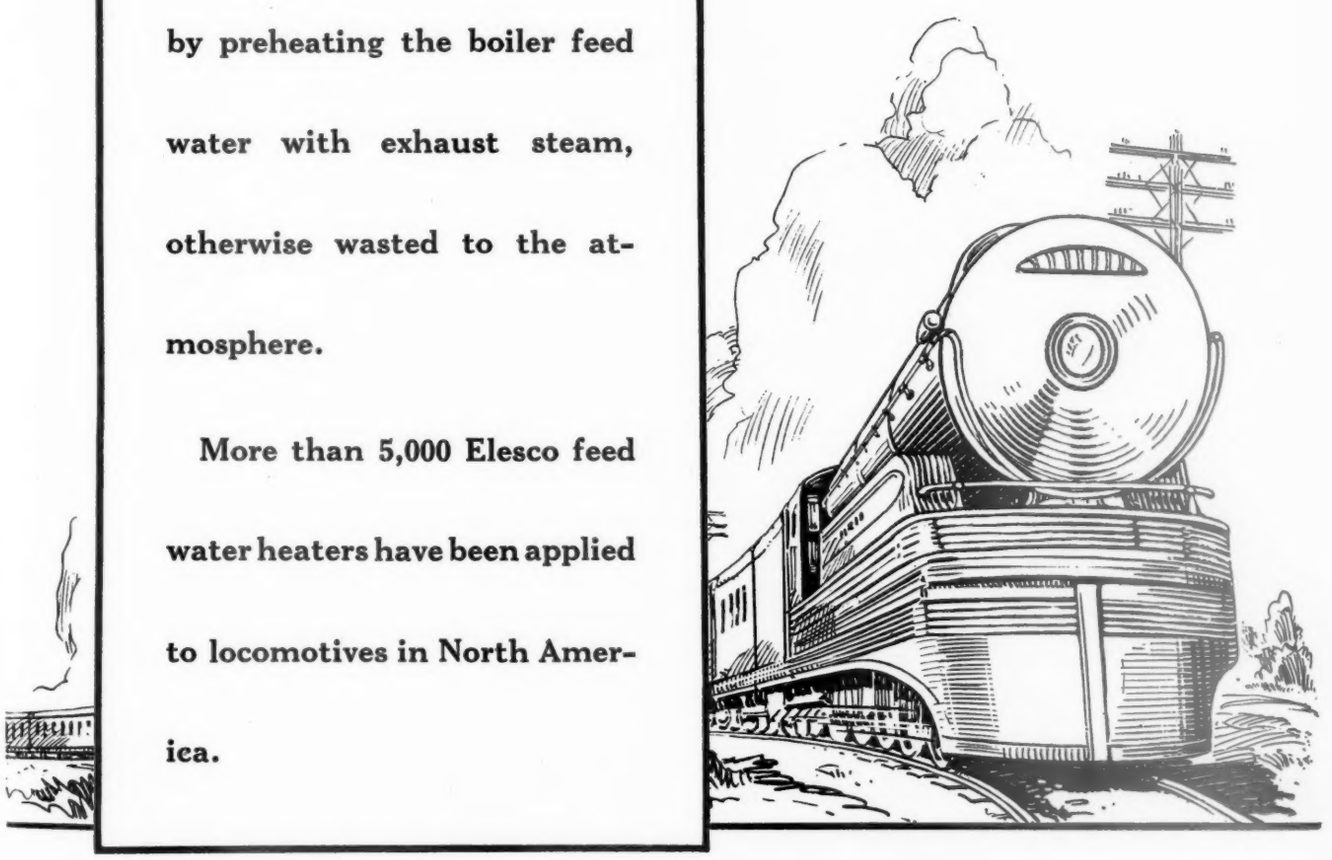
12%-15% More Power
from the same locomotive

The Elesco feed water heater provides this increase in power by preheating the boiler feed water with exhaust steam, otherwise wasted to the atmosphere.

More than 5,000 Elesco feed water heaters have been applied to locomotives in North America.



THE SUPERHEATER COMPANY

Representative of American Throttle Company, Inc.

60 East 42nd Street
NEW YORK

Peoples Gas Building
CHICAGO

Canada:
The Superheater Company, Limited, Montreal

A—1127

Superheaters • Superheater Pyrometers • Exhaust Steam Injectors • Steam Dryers • Feed Water Heaters • American Throttles

Financial

ALABAMA, TENNESSEE & NORTHERN.—*Reorganization.*—The Manufacturers Trust Company of New York City, trustee of the prior lien mortgage of this company, has protested to the Interstate Commerce Commission against a plan of reorganization for this road which has been proposed by the commission's Bureau of Finance.

ATCHISON, TOPEKA & SANTA FE-DENVER & RIO GRANDE WESTERN.—*Joint Operation.*—The Interstate Commerce Commission, Division 4, has authorized the Santa Fe to operate, under trackage rights, over a line of the Denver & Rio Grande Western from South Denver, Colo., to Bragdon, 104.95 miles; and the Denver & Rio Grande Western to operate, under trackage rights, over a line of the Santa Fe between the same points, 102.93 miles.

ATCHISON, TOPEKA & SANTA FE.—*Equipment Trust Certificates.*—The Interstate Commerce Commission, Division 4, has authorized this company to assume liability for $13,800,000 of 2¼ per cent serial equipment trust certificates, maturing in 15 equal annual installments of $920,000 on February 15, from 1938 to 1952. The issue has been sold to the Prudential Insurance Company of America at 100.353, making the average annual cost to the company approximately 2.2 per cent.

BALTIMORE & OHIO.—*Abandonment.*—The Interstate Commerce Commission, Division 4, has authorized this company and the Toledo & Cincinnati to abandon the latter's Superior No. 10 Mine branch extending from a point of connection with its Buckeye branch at Downardsville to the end of the line, 1.65 miles, together with its Rich Run Mine branch, 0.94 miles, all in Jackson county, Ohio.

CASEY & KANSAS.—*Abandonment.*—This company has applied to the Interstate Commerce Commission for authority to abandon a line extending from Kansas, Ill., to Casey, 19 miles.

CHESAPEAKE & OHIO.—*Joint Operation.*—This company has applied to the Interstate Commerce Commission for authority to operate, under trackage rights, over tracks of the New York, Chicago & St. Louis; Illinois Central; and the Chicago & Western Indiana in Chicago.

CHICAGO GREAT WESTERN.—*Notes.*—The Interstate Commerce Commission, Division 4, has authorized the trustees to issue $477,795 of 3¼ per cent promissory notes, maturing in 20 semi-annual installments beginning October 1 and ending April 1, 1947. The notes will be dated April 1, and will be payable to the Pullman-Standard Car Manufacturing Company.

CHICAGO, ROCK ISLAND & PACIFIC.—*Preferred Committee.*—The protective committee for the 7 per cent and 6 per cent preferred stocks of this company, headed by Carter H. Harrison, Jr., has announced that it now holds authorizations from holders of 40 per cent of these issues and has received deposits totaling 8 per cent. In a letter to holders, the committee asks for additional deposits and states that it will continue to oppose any move under which any of the company's pledged collateral would be sold. Summarizing the situation, the committee's letter says:

"Potential elements of recovery exist throughout the Rock Island lines and territory. Estimates of the trustees heretofore placed in evidence indicate that 1937 earnings of the system may approximate $4,000,000 after taxes and rents. This compares with $800,000 for 1936 and would be the best since 1932, when $4,265,429 was earned before interest. The committee is of the opinion that recovery will go very much further than this in the next two or three years, and is prepared to submit evidence and testimony in support of this view. In the light of such prospects, it would appear reasonable for Rock Island preferred stockholders to look forward to a considerable re-establishment of their equity."

ERIE.—*Abandonment.*—The Interstate Commerce Commission, Division 4, has authorized this company to abandon a part of its line extending from Highland Mills, N. Y., to West Cornwall, 7.08 miles.

ERIE.—*Annual Report.*—The 1936 annual report of this company shows net income, after interest and other charges, of $2,195,014, as compared with a net deficit of $852,400 in 1935. Selected items from the Income Statement follow:

	1936	1935	Increase or Decrease
Railway Operating Revenues	$85,005,111	$75,094,587	+$9,910,523
Maintenance of way	6,993,378	6,811,021	+182,357
Maintenance of equipment	15,711,879	14,312,478	+1,399,400
Transportation	30,505,475	28,182,756	+2,322,718
Total Operating Expenses	58,882,551	54,793,413	+4,089,137
Operating ratio	69.27	72.97	−3.70
Net Revenue from Operations	26,122,560	20,301,173	+5,821,386
Railway tax accruals	6,114,339	3,978,079	+2,136,260
Railway operating income	20,008,220	16,323,094	+3,685,125
Net rents—Dr.	3,669,430	3,362,368	+307,061
Net Railway Operating Income	16,338,790	12,960,726	+3,378,064
Non-operating income	1,298,099	1,752,873	−454,773
Gross Income	17,636,890	14,713,599	+2,923,290
Rent for leased roads and equipment	1,991,596	2,130,225	−138,628
Interest on funded debt	12,071,815	12,159,710	−87,895
Total Fixed Charges	14,715,801	14,737,025	−21,224
Net Income	$2,195,014	*$852,400	+$3,047,414

* Deficit.

ELGIN, JOLIET & EASTERN.—*Equipment Trust Certificates.*—The Interstate Commerce Commission, Division 4, has authorized this company to assume liability for $2,250,000 of 2½ per cent serial equipment trust certificates, maturing in 15 equal annual installments of $150,000 on March 1, from 1938 to 1952. The issue has been sold to the Prudential Insurance Company of America, at 100.702, making the average annual cost to the company approximately 2.41225 per cent.

KANSAS & SIDELL.—*Abandonment.*—This company has applied to the Interstate Commerce Commission for authority to abandon a line extending from Kansas, Ill., to Sidell, 8 miles.

MAINE CENTRAL.—*Annual Report.*—The 1936 annual report of this road shows a net deficit, after interest and other charges, of $82,615, as compared with net income of $134,541 in 1935. Selected items from the Income Account follow:

	1936	Increase or Decrease from 1935
Average mileage operated	1,010.18	−35.97
Railway Operating Revenues	$12,222,116	+$791,610
Maintenance of way	2,037,549	+409,402
Maintenance of equipment	2,048,347	+129,813
Transportation	4,545,628	+287,852
Total Operating Expenses	9,251,712	+822,814
Operating ratio	75.70	+2.16
Net Revenue from Operations	2,970,403	−53,204
Railway tax accruals	785,372	+191,732
Railway operating income	2,186,031	−244,937
Equipment and joint facility rents—Net Dr.	718,094	+96,857
Net Railway Operating Income	1,467,936	−341,794
Non-operating income	486,699	−24,131
Gross Income	1,954,636	−365,925
Rent for leased roads	598,746	−104,438
Interest on funded debt	1,243,526	−31,299
Total Deductions from Gross Income	2,037,251	−148,769
Net Income (Deficit)	$82,615	−$217,156

MAINE CENTRAL.—*Stock Sale.*—Lee, Higginson & Co., of Boston, it is reported have sold to a group of New England business men a large block of the capital stock (approximately 25 per cent of the total outstanding) of this company.

MISSOURI PACIFIC.—*To Sue VanSweringen Estate.*—United States District Judge George H. Moore has ordered Guy A. Thompson, trustee of the Missouri Pacific to file suit against the O. P. VanSweringen estate and four directors of the railroad to recover losses incurred in the purchase by the railroad of its own stock through a subsidiary several years ago.

NEW YORK CENTRAL.—*Abandonment.*—The Interstate Commerce Commission, Division 4, has authorized this company to abandon its line extending from Tupper Lake Junction, N. Y., to Helena, 62.6 miles; and to operate, under trackage rights, over a line operated by the Canadian National from Massena, N. Y., to Helena.

NEW YORK, NEW HAVEN & HARTFORD.—*New Trustee.*—Henry B. Sawyer has applied to the Interstate Commerce Commission for ratification of his appointment as a trustee of this company in place of W. M. Daniels, who has been relieved by the court on account of illness.

NEW YORK, NEW HAVEN & HARTFORD.—*Abandonment.*—The trustees have asked the Interstate Commerce Commission for authority to abandon the following branch lines: From Tariffville Station, Conn., to

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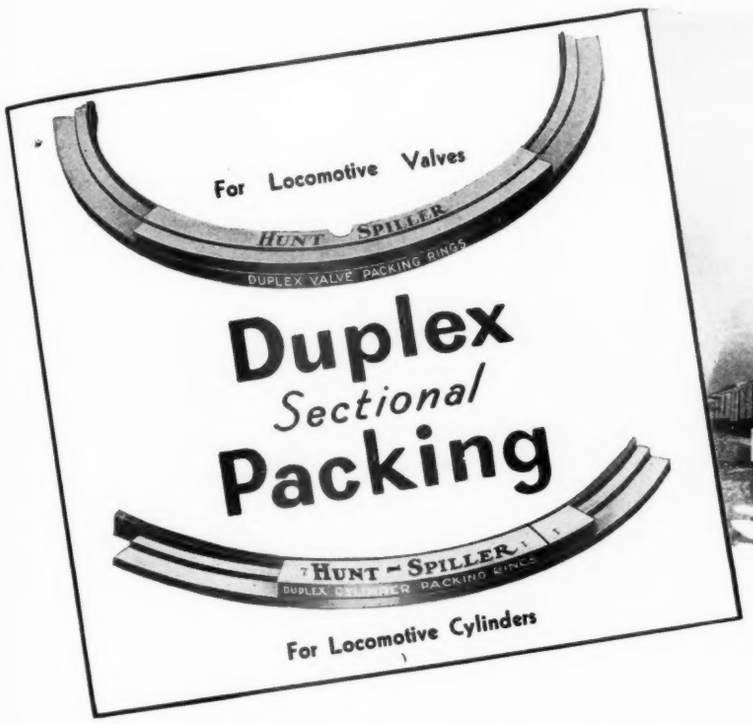


REDUCES OPERATING COSTS

LESS fuel per ton or passenger mile and lower maintenance costs are reported from the many railroads which have standardized on Duplex Sectional Packing.

Troublesome leaks and blows of Valves and pistons are eliminated. Duplex Sectional Packing remains tight over long periods of time.

The design of this packing, both sections of equal radial depth, provides longer service with freedom from breakage. The carefully formed and heat treated Duplex Springs maintain continuous ring contact sealing the Valves and Cylinders.

Applications of HUNT-SPILLER Duplex Sectional Packing to all your locomotives will result in a big saving in fuel and maintenance costs.

HSGI
Reg. U. S. Trade Mark
Cylinder Bushings
Cylinder Packing Rings
Pistons or Piston Bull Rings
Valve Bushings
Valve Packing Rings
Valve Bull Rings
Crosshead Shoes
Hub Liners
Shoes and Wedges
Floating Rod Bushings
Parts Finished For Application
Dunbar Sectional Type Packing
Duplex Sectional Type Packings for Cylinders and Valves
(Duplex Springs for Above Sectional Packing)
Cylinder Snap Rings
Valve Rings All Shapes

HUNT-SPILLER MFG. CORPORATION
V. W. Ellet Pres. & Gen. Mgr. / E. J. Fuller Vice-President
Office & Works
383 Dorchester Ave. **South Boston, Mass.**
Canadian Representative: Joseph Robb & Co., Ltd., 5575 Cote St. Paul Rd., Montreal, P.Q.
Export Agent for Latin America:
International Rwy. Supply Co., 30 Church Street, New York, N. Y.

HUNT-SPILLER GUN IRON

Air Furnace

Simsbury Station, 3.31 miles; from Simsbury, Conn., to Collinsville, 6.8 miles; from Griffins Station, Conn., to Tariffville, 2.71 miles; from Tariffville, Conn., to Agawan Junction, Mass., 14.3 miles; from State Line, N. Y., to Rhinecliff, 41.87 miles; from Lakeville, Conn., to State Line, N. Y., 2.76 miles; from Winsted, Conn., to East Canaan, 15.12 miles; from Collinsville, Conn., to Winsted, 11.34 miles.

NEW YORK, ONTARIO & WESTERN.—*Annual Report.*—The 1936 annual report of this company shows a net deficit, after interest and other charges, of $330,843, as compared with net income of $3,585 in 1935. Selected items from the Income Account follow:

	1936	Increase or Decrease from 1935
RAILWAY OPERATING REVENUES	$8,705,934	+$115,875
Maintenance of way	920,311	−960
Maintenance of equipment	1,605,663	+121,889
Transportation—Rail	3,614,882	+69,885
TOTAL OPERATING EXPENSES	6,583,844	+194,089
Operating ratio	75.62	+1.24
NET REVENUE FROM OPERATIONS	2,122,090	−78,214
Railway tax accruals	570,741	+173,105
Railway operating income	1,551,349	−251,319
Equipment rents—Net	431,893	+79,034
Joint facility rents—Net	78,817	−10,432
NET RAILWAY OPERATING INCOME	1,040,637	−319,922
Non-operating income	210,356	−29,154
GROSS INCOME	1,250,994	−349,077
Rent for leased roads	234,275	+3,952
Interest on funded debt	1,233,788	+15,764
TOTAL DEDUCTIONS FROM GROSS INCOME	1,581,837	−14,648
NET INCOME (DEFICIT)	$330,843	−$334,428

NEW YORK, SUSQUEHANNA & WESTERN.—*Annual Report.*—The 1936 annual report of this company shows a net deficit, after interest and other charges, of $400,731 as compared with net deficit of $379,342 in 1935. Selected items from the Income Statement follow:

	1936	1935	Increase or Decrease
RAILWAY OPERATING REVENUES	$3,451,958	$3,527,612	−$75,653
Maintenance of way	311,783	319,368	−7,585
Maintenance of equipment	421,896	537,773	−115,876
Transportation	1,486,188	1,459,803	+26,384
TOTAL OPERATING EXPENSES	2,440,633	2,528,254	−87,620
Operating ratio	70.70	71.67	−.97
NET REVENUE FROM OPERATIONS	1,011,325	999,358	+11,966
Railway tax accruals	358,084	257,156	+100,927
Railway operating income	653,240	742,201	−88,960
Net rents—Dr.	320,024	385,223	−65,198
NET RAILWAY OPERATING INCOME	333,216	356,977	−23,761
Non-operating income	63,890	63,661	+228
GROSS INCOME	397,106	420,638	−23,532
Rent for leased roads and equipment	27,258	27,249	+9
Interest on funded debt	755,112	755,847	−735
TOTAL FIXED CHARGES	789,753	790,398	−645
NET INCOME (DEFICIT)	$400,731	$379,342	−$21,388

PITTSBURGH & WEST VIRGINIA.—*Equipment Trust Certificates.*—The Interstate Commerce Commission, Division 4, has authorized this company to assume liability for $260,000 of 2¼ per cent equipment trust certificates, maturing in 10 equal annual installments on April 1, from 1938 to 1947. The issue has been sold to A. G. Becker & Co. of New York at 94.77, making the average annual cost to the company approximately 3.4 per cent.

ST. LOUIS SOUTHWESTERN.—*Reorganization.*—The Chase National Bank of New York and the Mississippi Valley Trust Company of St. Louis, having been permitted to intervene, have filed a suggested plan of reorganization for this company with the Interstate Commerce Commission and the district court of the United States for the Eastern district of Missouri. The banks' plan differs from that of the debtor primarily in a proposal to pay off general and refunding mortgage bonds (which the banks hold as collateral) by 60 per cent in first terminal and unifying mortgage bonds and the balance (plus back interest) in preferred stock; instead of, as the debtor proposed, paying off this issue in debentures.

SHARON.—*Bonds.*—The Interstate Commerce Commission, Division 4, has authorized this company to extend from January 1, 1937, to January 1, 1962, the date of maturity of $164,000 of first mortgage bonds of this company and $250,000 of first mortgage bonds of the New Castle & Shenango Valley, with interest at 4 per cent.

SOUTHERN PACIFIC.—*Equipment Trust Certificates.*—The Interstate Commerce Commission, Division 4, has authorized this company to assume liability for $11,220,000 of 2¼ per cent equipment trust certificates, maturing in 15 equal annual installments of $748,000 on March 1, from 1938 to 1952. The issue has been sold to a group composed of Salomon Brothers & Hutzler, Dick & Merle-Smith, and Stroud & Co., Inc., at 97.377, making the average annual cost to the company approximately 2.66 per cent.

UNION PACIFIC.—*Abandonment.*—Examiner C. P. Howard of the Interstate Commerce Commission, in a proposed report, has recommended that the commission authorize the Los Angeles & Salt Lake to abandon that part of its Frisco branch between Frisco, Utah, and Newhouse, 6 miles; that the Union Pacific abandon operation of this line; and that the commission deny authority to abandon that part of the branch between Frisco, Utah, and milepost No. 1 at Milford, 16 miles. The examiner also recommends that operation of this latter branch may be abandoned, without prejudice to the renewal of the application after the expiration of two years.

TEMISKAMING & NORTHERN ONTARIO RAILWAY COMMISSION.—*Annual Report.*—Subsequent to October 31, 1934, the end of the fiscal year covered by the last published annual report of the above Commission, it was decided to change the financial year to conform with that of the Province. The annual report for the railway just released, covering the period from November 1, 1934, to March 31, 1935, shows a net income, after interest and other charges, of $72,453, as compared with net income of $57,541 for the corresponding period in 1933-34. Selected items from the income statement follow:

	Nov. 1, 1934 to Mar. 31, 1935	Nov. 1, 1933 to Mar. 31, 1934	Increase or Decrease
RAILWAY OPERATING REVENUES	$1,551,712	$1,418,664	+$133,048
Maintenance of Way	302,844	235,472	+67,372
Maintenance of Equipment	238,337	244,336	−5,999
Transportation	543,943	508,243	+35,700
TOTAL OPERATING EXPENSES	1,211,393	1,132,763	+78,630
BALANCE	340,319	285,900	+54,419
Other Income:			
Hire of Freight Cars—Dr.	53,744	54,982	+1,238
Joint Facility Rents—Net	9,614	9,597	+17
Interest—Funded Debt	100,000	100,000	.....
TOTAL	267,865	228,359	+39,506
NET INCOME	$72,453	$57,541	+$14,912

Average Prices of Stocks and Bonds

	Mar. 16	Last week	Last year
Average price of 20 representative railway stocks	60.77	60.70	48.51
Average price of 20 representative railway bonds	83.80	84.97	80.76

Dividends Declared

Dover & Rockaway.—$3.00, semi-annually, payable April 1 to holders of record March 31.

Joliet & Chicago.—$1.75, payable April 5 to holders of record March 24.

Providence & Worcester.—$2.50, quarterly, payable April 2 to holders of record March 10.

Virginian.—$2.00, quarterly, payable March 31 to holders of record March 17; Preferred, $1.50, payable May 1 to holders of record April 10.

Construction

PENNSYLVANIA.—A contract has been given to the L. A. Wells Construction Company, Cleveland, Ohio, for repairs to ore dock No. 8 at Erie, Pa.

PENNSYLVANIA.—A contract has been given to the Centaur Construction Company, Inc., New York, for the elimination of the grade crossing at Colonia boulevard and Sucker Brook road, Colonia, N. J.

PENNSYLVANIA.—The contracts for electrification on the Pennsylvania cover the sections from Paoli, Pa., to Harrisburg; Perryville, Md., to Enola, Pa., and Monmouth Junction, N. J., to South Amboy. These were let to the Arundel Corporation, Baltimore, Md.; Vare Brothers, Philadelphia, Pa.; Louchheim, Brown & MacDonough, Philadelphia, and James McGraw Company, Philadelphia.

SENATOR MURRAY OF MONTANA and Representative Mapes of Michigan have introduced in Congress identical bills which are designed to force the railroads to file standards of maintenance of way and inspection standards with the Interstate Commerce Commission for its approval. Thereafter it would be the duty of the Commission to see that these standards are lived up to.

Railway Officers

EXECUTIVE

Ralph Simpson, whose appointment as assistant to the vice-president and general manager of the Minneapolis, St. Paul & Sault Ste. Marie (Soo Line), with headquarters at Minneapolis, Minn., was reported in the *Railway Age* of March 13, has been in railway service for 30 years. He was born on December 26, 1892, at Stratford, Ont., and first entered railway service with the Grand Trunk (now Canadian National) in September, 1907, as a special apprentice. From March, 1913, to March, 1916, he served in the mechanical engineer's office of the Grand Trunk Pacific, then entering the service of the Soo Line as a mechanic. Following a year in the latter capacity Mr. Simpson joined the Northern Pacific, where he served as a draftsman until July, 1917, when he returned to the Soo Line as chief draftsman. In February, 1923, he was promoted to mechanical engineer of the Soo Line, which position he held until his recent appointment as assistant to the vice-president and general manager.

Ralph Simpson

OPERATING

J. L. Wittenmeyer, special representative in the office of the general manager of the Chicago, Rock Island & Pacific at Kansas City, Mo., has been appointed acting assistant superintendent at Trenton, Mo., to succeed **Bluford Johnson,** who has been granted a leave of absence.

L. B. Denton, trainmaster on the Chicago, Burlington & Quincy, with headquarters at Alliance, Neb., has been appointed acting assistant superintendent of the Sheridan division, with headquarters at Sheridan, Wyo., to succeed **D. J. Nelson,** who has been granted a leave of absence.

MECHANICAL

L. D. Richards, superintendent motive power on the Chicago, Rock Island & Pacific with headquarters at Kansas City, Mo., has been appointed master mechanic at Shawnee, Okla., to succeed **A. R. Ruiter,** who has been transferred to Armourdale, Kan., where he replaces **W. B. Embury,** who has been transferred to Little Rock, Ark. Mr. Embury replaces **R. C. Hyde,** who has been appointed assistant master mechanic at Fort Worth, Tex.

TRAFFIC

W. O. Dodge, general agent for the St. Louis-San Francisco at Philadelphia, Pa., has been appointed general eastern agent, succeeding **W. L. McDonald. F. G. Brown,** perishable agent at New York, has been appointed eastern perishable agent with the same headquarters.

J. W. Stevenson, who has been promoted to assistant passenger traffic manager of the Illinois Central, was born in Chicago on September 17, 1888, and entered railway service in 1903 as an office boy for the Western Passenger Association. After subsequent service on the Chicago Great Western as a rate clerk, he entered the employ of the Illinois Central in the same capacity in 1912. In two years he rose to chief clerk of the passenger department, and in 1920, after a short experience as district passenger agent in Chicago, became chief clerk of the traffic department. In 1921 he was promoted to assistant general passenger agent, which position he has held until his recent promotion.

J. W. Stevenson

ENGINEERING AND SIGNALING

J. C. Bousfield, assistant chief engineer of the Wabash, has been promoted to chief engineer, effective March 16, with the same headquarters, to succeed **E. L. Crugar,** deceased.

Hadley Baldwin, special engineer of the Cleveland, Cincinnati, Chicago & St. Louis and formerly chief engineer of this company, with headquarters at Cincinnati, Ohio, retired from service on March 1, having reached the age of 70 years.

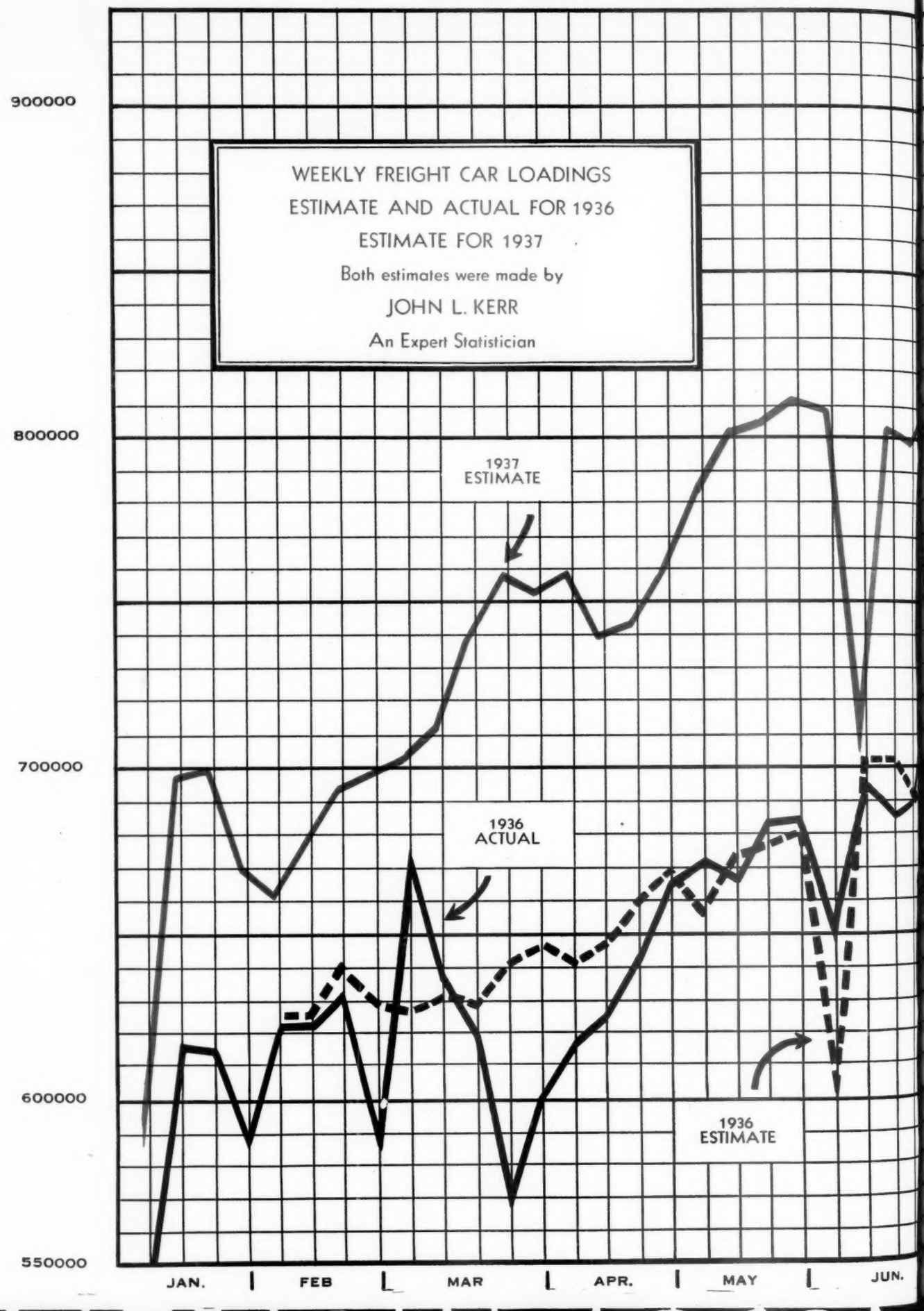
OBITUARY

Henry E. Kramer, assistant general freight agent of the Louisville & Nashville, died in Louisville, Ky., on March 15.

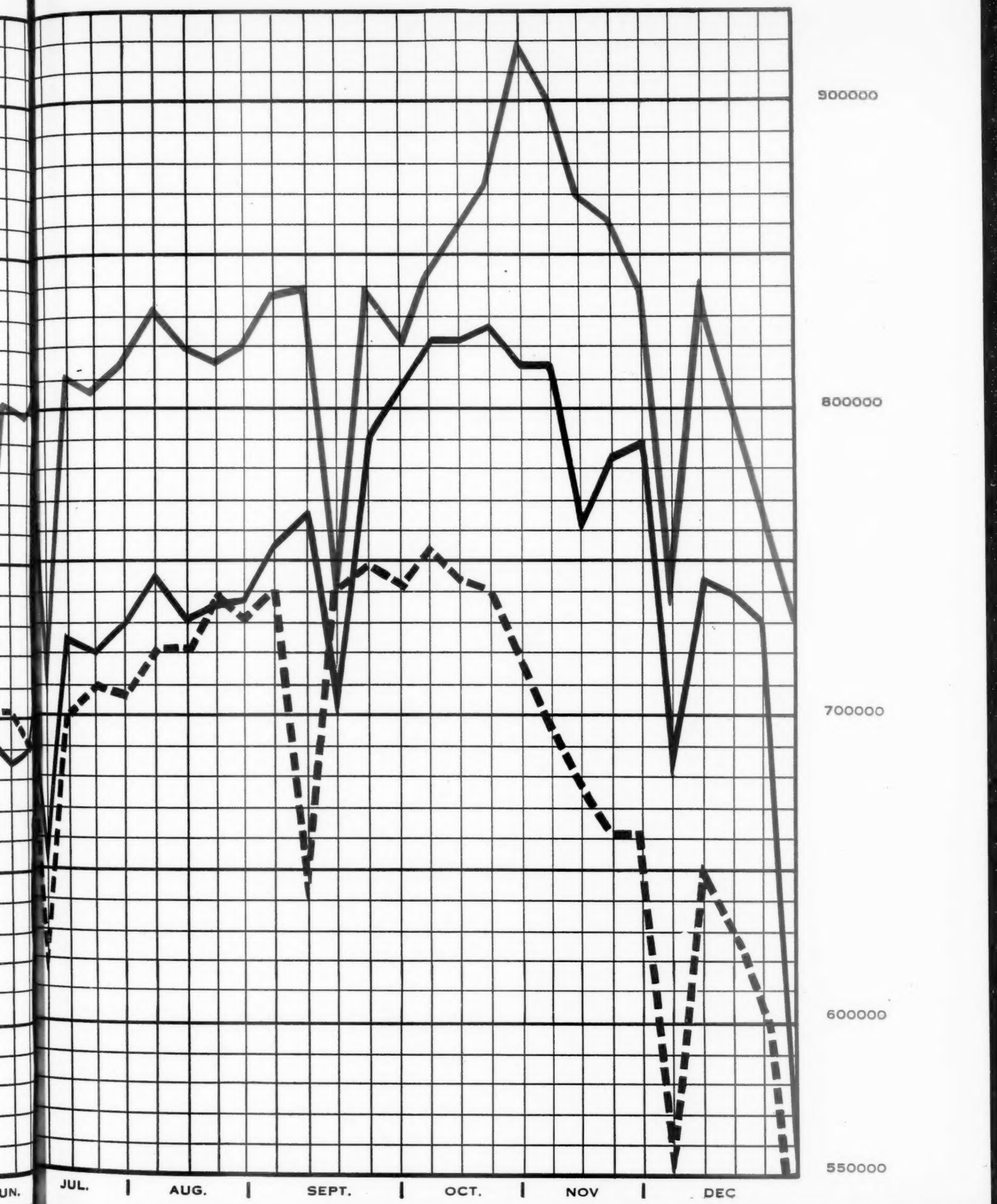
David L. Meyers, assistant freight traffic manager of the Atchison, Topeka & Santa Fe, with headquarters at Chicago, died on March 15 in La Grange, Ill., following a short illness. He was born in Cape Girardeau, Mo., and entered the service of the Santa Fe at Chicago on April 2, 1893, and until September, 1898, worked consecutively as tariff clerk, rate clerk, and chief rate clerk in the general freight office. From September, 1898, to October, 1905, he was chief clerk to the freight traffic manager. He was appointed general freight and passenger agent of the Panhandle & Santa Fe at Amarillo, Tex., in October, 1905, and acted in that capacity until September, 1909, when he came to Chicago as assistant general freight agent. He was appointed assistant freight traffic manager in March, 1920.

Charles C. Dana, freight traffic manager of the Atchison, Topeka & Santa Fe, with headquarters at Chicago, died in that city on March 15 following a short illness. He was born on August 7, 1868, in Morrisville, N. Y., and graduated from Princeton in 1891. Upon graduation he became a reporter for the New York Sun, and in December, 1891, resigned to enter the employ of the Atchison, Topeka & Santa Fe as a clerk in the general manager's office at Topeka, Kan. After holding the position of material agent on construction work at Los Cerillos, N. M., and clerk to the assistant superintendent at Fort Madison, Iowa, he was agent at Pekin, Ill., from 1895 to 1898, traveling freight agent from 1898 to 1904, division freight agent at Fort Madison, Iowa, from 1904 to 1913, and industrial commissioner at Chicago from 1913 to 1916. In the latter year he was appointed general freight and passenger agent of the Panhandle & Santa Fe at Amarillo, Tex., and in 1918 and 1919 was with the Railroad Administration in Washington, D. C. In 1920 he was appointed general freight agent at Chicago, and in 1922 was promoted to assistant freight traffic manager, which position he held until 1927, when he was promoted to freight traffic manager, the position he was holding at the time of his death.

Charles C. Dana



AMERICAN LOCO



OTIVE COMPANY